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REPORT

Groundwater Monitoring Report
December 2005
Terminal 5 Upland Facility

Port of Portland
Portland, Oregon 97209

January 2006

NEWFIELDS

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

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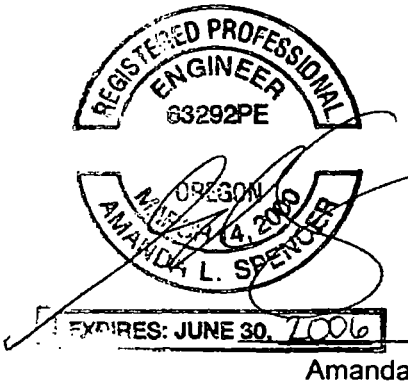

Respectfully submitted,

Amanda L. Spencer, P.E., R.G.
Principal, Ash Creek Associates

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1. Introduction

This Groundwater Monitoring Report describes the results of groundwater monitoring conducted in December 2005 at the Terminal 5 Upland Facility (Facility) in Portland, Oregon (See Figure 1). The Port of Portland (Port) conducted a Preliminary Assessment (PA) of the Terminal 5 Upland Facility (the Facility) at the request of the Oregon Department of Environmental Quality (DEQ). The results of the PA are contained in a report prepared by the Port dated August 25, 2000. DEQ provided comments on the PA report in a letter dated May 15, 2001, and the Port responded to those comments in a letter dated August 31, 2001.

In a letter to the Port dated March 14, 2005, the DEQ noted two unresolved issues, both involving the former "Blue Lagoon" in the southern portion of the Facility. As the first issue, the DEQ noted that previous groundwater sampling results indicated that three metals (barium, iron, and manganese) have historically exceeded certain chronic freshwater ambient water quality criteria (AWQC) or DEQ Level II Ecological Screening Level Values (SLVs) and requested the three monitoring wells at the Facility be sampled for the presence of these total and dissolved metals. This report documents the results of this sampling event. The second issue regarded sediment from the former Blue Lagoon that has been subsequently buried. The DEQ requested that the sediment be appropriately managed to protect potential current and future human or ecological exposure. A Contaminated Area Media Management Plan (CAMMP; Ash Creek Associates, 2006) has been submitted to the DEQ to address this second issue.

1.1 Scope of Work

The scope of work for the December 2005 groundwater monitoring event consisted of:

- Groundwater level measurement for estimation of shallow groundwater gradient at the Facility (groundwater level measurements were conducted simultaneous with water level measurements collected by others at the adjacent Oregon Steel Mill (OSM) site),
- Groundwater sampling of three on-site wells (MW-2 through MW-4), and
- Chemical analysis of collected samples for barium, iron, and manganese (both total and dissolved concentrations).

1.2 Report Organization

This report provides background information about the Facility (Section 2.0), and a discussion of the groundwater monitoring program and results (Section 3.0). Documents referenced in the report are listed in Section 4.0. Supporting information is provided in the table, figures, and appendices. Appendix A presents the Sampling and Analysis Plan (SAP) including procedures and quality assurance/quality control (QA/QC) protocols for the groundwater monitoring program. Appendix B provides copies of the field sampling sheets. Appendix C provides a description of the Data Quality Review of the analytical data and copies of the analytical laboratory reports.

2. Background

This section summarizes the physical setting of the Facility and facility geology and hydrogeology. Information source presented in this section was obtained from the PA report (Port of Portland, 2000) unless noted otherwise.

2.1 Facility Location and Description

The Facility is a 173-acre site located on the east bank of the Willamette River (near River Mile 2.0). It is located in the Rivergate Industrial District in north Portland. Adjacent properties include OSM to the south, Columbia Slough and Kelly Point Park to the north, Union Pacific Railroad and North Lombard Street to the east, and the Willamette River to the west. The Facility has consisted of three tenant properties: a mineral bulk facility leased and operated by Portland Bulk Terminals; a grain terminal leased and operated by Columbia Grain, Inc.; and Alcatel Submarine Networks.

2.2 Geology

The Facility is located in the Portland basin, a northwest-southeast trending basin that is approximately 20 miles wide by 45 miles long. This structural basin is filled with consolidated and unconsolidated continental sedimentary rocks. Older rocks that underlie the basin-fill sediments include the Skamania Volcanics; Columbia River Basalt Group; basalts of the Waverly Heights, Goble Volcanics, Pittsburg Bluff, Scappoose, and the Rhododendron Formations. The Sandy River Mudstone and the Troutdale Formation are the oldest of the basin-filling sediments. Large quantities of Pleistocene sediments were deposited during catastrophic floods of the Columbia River. These floods occurred as a result of the periodic failures of ice dams impounding huge lakes in Idaho and Montana. The catastrophic flood deposits can be grouped into two easily discernable lithologic units: a basaltic sand and gravel unit with varied amounts of cobbles and boulders; and, a finer, stratified, micaceous arkosic sand, silt, and clay. The former unit is present near the Columbia River channel in southern Clark County and north Portland. Alluvium deposits from the Columbia River were deposited on the Pleistocene sediments. The alluvium deposits consist of sand and silt.

Surface soils at the Facility are made up of hydraulically placed sands and silty sands underlain by recent alluvium of the Columbia River floodplain. Borings installed in the area where the coal export facility was constructed indicated that the sand fill was approximately 7 feet thick. The sand fill overlies approximately 40 to 50 feet of alluvium comprised of soft medium stiff clayey silt with sand layers. Immediately underlying this alluvium are Pleistocene silts, sands, and gravels ranging in thickness from 100 to 200 feet.

2.3 Hydrogeology

The Facility is within the Portland Basin hydrogeologic system. Eight major hydrogeologic units form the Portland Basin hydrogeologic system. Proceeding from oldest to youngest, these units include: older rocks; Sand and Gravel Aquifer (SGA); Confining Unit 2 (CU2); Troutdale Sandstone Aquifer (TSA); Confining Unit 1 (CU1); unconsolidated sedimentary rock aquifer; consolidated gravel aquifer; and undifferentiated fine-grained sediments.

Monitoring wells at the Facility are screened across the first encountered water bearing zone which is contained in the sand fill and upper portion of the recent alluvium. Depth to water has been reported at approximately 2 to 7 feet below grade in the former Blue Lagoon area of the Facility. Groundwater has been reported to flow to the west and south.

2.4 Prior Investigations

Several phases of investigation were conducted in the area of the former Blue Lagoon to assess for the presence of chemicals in the residual sediments and the potential impact the sediment had on surrounding soil and groundwater. Studies with analytical data included:

- 1993 Facility Investigation – Century West Engineering installed four groundwater monitoring wells (MW-1 through MW-4) and sampled lagoon water, sediment, soil, and groundwater (Century West, 1994).
- 1995 Facility Investigation – PTI Environmental Services sampled lagoon water, sediment, groundwater, and background soil (PTI, 1995).
- Groundwater Monitoring – Groundwater samples were collected from the monitoring wells on eight occasions between October 1993 and December 2005 (Hahn and Associates, 1999, BBL/Ash Creek/Newfields, 2006).

On September 7, 2000, the Port submitted a PA of Terminal 5 to the DEQ in response to a request by the DEQ. Soil and groundwater data from the previous studies were summarized in the August 25, 2000 Preliminary Assessment.

Table 1 summarizes the previous historical groundwater sampling results for total and dissolved metals analysis. DEQ's Level II Ecological Screening Level Values (SLVs) for freshwater aquatic receptors are included on the table for reference. As can be seen from the table, preliminary groundwater results indicated several metals exceeding screening levels. The elevated results were attributed to sampling procedures because low flow sampling techniques were not employed during the events that recorded these elevated concentrations. The last four consecutive quarters of monitoring conducted between October 1998 and October 1999 employed low flow technology and did not indicate any metals exceeding the SLVs, with the exception of barium, iron, and manganese. The Port and its consultants previously concluded that it would be unlikely that the iron, barium, or manganese could reach the river at concentrations of concern, given the distance of the former Blue Lagoon area from the Willamette River (1200 feet).

The DEQ noted in its March 14, 2005 letter to the Port, that the last time the Facility groundwater monitoring wells were sampled was in October 1999. To enable a No Further Action determination for the Facility, the DEQ requested water levels be measured and the wells be resampled to allow for an assessment of current groundwater conditions and the likelihood that iron, barium, and manganese could migrate to the Willamette River at concentrations of concern.

3. Groundwater Monitoring

Monitoring wells MW-2, MW-3, and MW-4 were redeveloped on December 12, 2005, to assist in the requested monitoring event. Prior to redevelopment, water levels were measured in the three monitoring wells; these water level measurements were coordinated with water level measurements collected by RETEC (consultant to OSM) at the adjacent OSM site. Groundwater sampling of the three wells at the Facility was conducted at least 48 hours following. A detailed discussion of the field and sampling procedures is contained in the SAP, included as Appendix A to this document. A brief description of monitoring procedures is provided below.

3.1 Groundwater Level Measurements

Groundwater elevations were measured in wells MW-2 through MW-4 on December 12, 2005. The wells were opened, and the water levels allowed to equilibrate before measurements were taken. The depth to groundwater was measured to the nearest 0.01 foot using an electronic probe. Measured depths to groundwater are included in Table 2.

Groundwater level measurements were coordinated with collection of measurements by RETEC at the adjacent OSM site so that a more regional evaluation of groundwater flow could be conducted. RETEC provided groundwater elevations estimated from the water levels collected at OSM on December 12, 2005; these are summarized on Figure 3. Figure 3 shows the estimated groundwater elevation contours at OSM and the southern portion of Terminal 5 based on the measurements collected on December 12, 2005. As shown on Figure 3, groundwater in the area of the former Blue Lagoon flows to the south and west-southwest. The gradient to the west-southwest (i.e., toward the Willamette River) is approximately 0.02. This groundwater flow and gradient is consistent with previously reported groundwater gradients.

3.2 Well Redevelopment

Because it has been 6 years since the last groundwater sampling event at wells MW-2, MW-3, and MW-4, the wells were redeveloped prior to sample collection. The wells were redeveloped by surging the wells with a submersible pump and purging 4 to 6 casing volumes of water from the wells to remove accumulated sediment from the well and enhance communication with the screened water bearing zone. The redevelopment activities are described in field notes contained in Appendix B. Turbidity in each of the wells was high; development activities continued until the turbidity reduced and stabilized and groundwater appeared relatively clear of sediment.

3.3 Groundwater Sample Collection

After allowing the wells to stabilize for 48 hours following redevelopment, groundwater samples were collected from wells MW-2 and MW-3 on December 14, 2005, and from MW-4 on December 15, 2005.

3.3.1 Purging

The monitoring wells were purged using a peristaltic pump and low flow sampling techniques as detailed in Appendix A. Groundwater pH, electrical conductivity, dissolved oxygen, turbidity, oxidation-reduction potential (ORP), and temperature were measured during purging. Temperature, pH, and electrical conductivity values were required to stabilize, as specified in the SAP (Appendix A) to confirm the effectiveness of the purging. Purging was considered complete when the field indicator parameters were stable for three consecutive readings. Stable values were defined as:

- Specific conductance: +/- 3% S/cm
- pH: +/- 0.1 pH units
- Temperature: +/- 1 degree C.

Table 1 summarizes the field parameters immediately prior to sample collection. Copies of field sampling sheets are contained in Appendix B.

3.3.2 Sample Collection

After purging was completed, the wells were sampled. Collected groundwater samples were submitted to Severn Trent Laboratories in Tacoma, Washington, for chemical analyses. All samples were collected in laboratory-supplied sample containers, marked with identifying information, and maintained under chain of custody protocols.

3.3.3 Sample Handling and Storage

Clean sample containers were provided by the analytical laboratory ready for sample collection. Sample jars were fully filled. A label was affixed to each sample container and marked with identifying information. Sample containers were stored in a cooled ice chest until transported to the analytical laboratory. Chain of custody was maintained and documented at all times.

3.3.4 Decontamination Procedures

Sampling equipment was either disposable or was cleaned before collection of each well sample. Cleaning of non-disposable items consisted of washing in a detergent (Alconox®) solution and two rinses with deionized water.

3.4 Analysis Results

Collected groundwater samples were submitted to the analytical laboratory and analyzed for barium, iron, and manganese by EPA Method 6020 (both dissolved and total metals analyses). Table 2 summarizes the analytical results for the collected samples. Previous groundwater sampling results and DEQ's Level II Ecological Screening Level Values (SLVs) are included on the table for reference. The dissolved barium, iron, and manganese concentrations are shown spatially on Figure 4. Laboratory data sheets are contained in Appendix C.

The results for barium, iron, and manganese are consistent with previous results. As can be seen in Table 3, total metals and dissolved metals analysis results were generally similar, with the dissolved

metals concentrations averaging about 85% of the total metals concentrations. Although these concentrations are above the SLVs for aquatic surface water receptors, they were substantially less than the highest observed concentrations for these metals (some are an order of magnitude less).

3.5 Evaluation of the Data and Conclusions

Preliminary groundwater sampling results conducted between 1993 and 1998 while the former Blue Lagoon area was being filled indicate several metals exceeding DEQ screening levels. However, four consecutive quarters of monitoring conducted between October 1998 and October 1999 after filling of the former pond was complete and using low flow sampling technology did not indicate any metals exceeding SLVs, with the exception of barium, iron, and manganese. The Port concluded it would be unlikely that these metals could reach the Willamette River at concentrations of concern because the former Blue Lagoon area is 1,200 feet from the river. In a letter to the DEQ dated August 31, 2001, the Port requested that the Facility be granted a No Further Action determination. In the March 14, 2005 letter from DEQ to the Port, the DEQ noted that it had been 6 years since the monitoring wells at the Facility had been sampled. Prior to issuing an NFA, the DEQ requested one additional monitoring event to assess the current groundwater conditions near the former lagoon and to evaluate the likelihood that barium, iron, and manganese constituents could migrate to the Willamette River at concentrations of concern.

Groundwater Flow. Groundwater flow in the southern portion of the Facility was south to west-southwest at the time of measurement on December 12, 2005. This flow direction is consistent with previous studies. The estimated west-southwest gradient (e.g., toward the river) is approximately 0.02. Assuming a hydraulic conductivity typical of riverfront sand fill of approximately 1 foot per day (0.3×10^{-3} cm/s; Freeze & Cherry, 1979) and a porosity of 25 percent, the estimated groundwater velocity from the former Blue Lagoon area toward the river is approximately 0.08 foot per day, or 30 feet per year. Therefore, it would require approximately 40 years for groundwater to travel from the lagoon to the river, a distance of approximately 1,200 feet.

Barium, Iron, Manganese Concentrations. The concentrations of barium, iron, and manganese are consistent with previous results. The concentrations are relatively low, and are considerably less than previously observed highest concentrations for these metals.

Conclusions. Although the barium, iron, and manganese concentrations are low, the concentrations exceed the DEQ Level II Ecological SLVs. However, as estimated above, it would likely take on the order of 40 years for groundwater from the former lagoon area to travel to the river. Based on this estimated groundwater velocity, the considerable distance of the former lagoon area to the river, and the low concentrations of iron, barium, and manganese, it does not appear likely that these constituents could reach the river or river sediments at concentrations of concern. These (and the previous) results support that the groundwater quality in the area of the former Blue Lagoon has only been minimally impacted (if at all) from the presence of the buried material and continues to improve. The groundwater in this area does not represent a potential source to the river and no further assessment or actions are needed.

4. References

Ash Creek Associates, 2006. Contaminated Area and Media Management Plan, Terminal 5 Upland Facility – January 2006 draft.

Freeze & Cherry, 1979. Groundwater. © 1979 by Prentice-Hall, Inc. Englewood Cliffs, N.J.

Port of Portland, 2000. Preliminary Assessment, Port of Portland Terminal 5. September 7, 2000.

TABLE 1
SUMMARY OF HISTORICAL METAL CONCENTRATIONS IN GROUNDWATER
TERMINAL 5 UPLAND FACILITY
PORT OF PORTLAND

Monitoring Well	Sample Date	Analyte Concentration in mg/L (ppm) Total Recoverable Metals											
		Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
MW-1	10/22/1993	< 0.020	0.068	0.558	< 0.002	0.274	0.112	--	0.048	--	0.0002	0.0954	< 0.003	0.326
	2/27/1995	< 0.020	< 0.050	0.727	< 0.002	0.15	0.0095	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	0.0085
	4/24/1996	< 0.050	0.009	0.66	< 0.005	0.2	0.02	--	0.019	--	< 0.0002	< 0.020	< 0.010	0.01
MW-2	10/22/1993	< 0.020	0.091	2.03	< 0.002	0.134	0.214	--	0.12	--	0.0012	0.133	< 0.003	0.658
	2/27/1995	< 0.020	< 0.050	0.101	< 0.002	< 0.005	0.002	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	< 0.005
	4/24/1996	< 0.050	0.019	1.69	< 0.005	0.16	0.2	--	0 06	--	0.0008	0.13	< 0.010	0.07
	10/2/1998	--	0.0099	0.0641	< 0.001	< 0.001	< 0.002	16.5	< 0.001	0.924	< 0.0002	< 0.002	--	< 0.005
	4/13/1999	--	0.0086	0.0313	< 0.001	< 0.001	0.0021	2.37	< 0.001	0.293	< 0.0002	< 0.002	--	< 0.005
	7/29/1999	--	0.0133	0.0145	< 0.001	< 0.001	0.0021	0.85	< 0.001	0.097	< 0.0002	< 0.002	--	< 0.005
	10/19/1999	--	0.012	0.0236	< 0.002	< 0.005	< 0.002	1.88	< 0.001	0.235	< 0.0002	< 0.010	--	< 0.010
MW-3	10/22/1993	< 0.020	< 0.050	0.234	< 0.002	0.0394	0.0459	--	< 0.025	--	< 0.0002	0.043	< 0.003	0.174
	2/27/1995	< 0.020	< 0.050	0.0079	< 0.002	< 0.005	< 0.002	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	< 0.005
	4/24/1996	< 0.050	0.008	0.12	< 0.005	0.01	0.02	--	0.007	--	< 0.0002	< 0.020	< 0.010	0.07
	10/2/1998	--	0.004	0.0091	< 0.001	< 0.001	< 0.002	3.06	< 0.001	0.506	< 0.0002	0.0026	--	< 0.005
	4/13/1999	--	0.002	0.0185	< 0.001	< 0.001	< 0.002	5	< 0.001	0.608	< 0.0002	< 0.002	--	< 0.005
	7/29/1999	--	0.0049	0.0132	< 0.001	< 0.001	< 0.002	6.95	< 0.001	0.57	< 0.0002	< 0.002	--	< 0.005
	10/19/1999	--	0.0036	0.0105	< 0.002	< 0.005	< 0.002	3.4	< 0.001	0.572	< 0.0004	< 0.010	--	< 0.010
MW-4	10/22/1993	< 0.020	0.092	0.949	0.0023	0.135	0.217	--	0.115	--	0.0011	0.152	< 0.003	0.646
	2/27/1995	< 0.020	< 0.050	0.0513	< 0.002	0.006	0.0063	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	< 0.005
	4/24/1996	< 0.050	< 0.005	0.09	< 0.005	0.01	0.02	--	0.006	--	< 0.0002	< 0.020	< 0.010	0.05
	10/2/1998	--	0.0104	0.0898	< 0.001	< 0.001	< 0.002	41.6	< 0.001	7.85	< 0.0002	0.0115	--	0.0077
	4/13/1999	--	< 0.001	0.0133	< 0.001	< 0.001	< 0.002	1.63	< 0.001	0.084	< 0.0002	0.002	--	< 0.005
	7/29/1999	--	0.0037	0 0405	< 0.001	< 0.001	< 0.002	7.97	< 0.001	1.19	< 0.0002	0.0072	--	< 0.005
	10/19/1999	--	0.0348	0.0896	< 0.002	< 0.005	< 0.002	71.8	< 0.001	7.4	< 0.0002	0.01	--	< 0.010
JSCS (DEQ values)		1.6	0.19	na	0.00038	0.011	0.0036	na	0.00054	na	0.000012	0.048	0.00012	0.0327
DEQ Level II SLV		1.6	0.15	0.004	0.0022	0.074	0.009	1.0	0.00250	0.12	0.000770	0.052	0.00012	0.12

Monitoring Well	Sample Date	Analyte Concentration in mg/L (ppm) Dissolved Metals												
		Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
MW-1	10/22/1993	< 0.020	< 0.050	0.0295	< 0.002	< 0.005	< 0.002	--	< 0.025	--	< 0.0002	0.011	< 0.003	< 0.005
	2/27/1995	< 0.020	< 0.050	0.566	< 0.002	0.107	< 0.002	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	< 0.005
	4/24/1996	< 0.050	< 0.005	0.81	< 0.010	0.18	< 0.010	--	0.004	--	< 0.0002	< 0.020	< 0.010	0.02
MW-2	10/22/1993	< 0.020	0.057	0.18	< 0.002	< 0.005	< 0.002	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	0.0096
	2/27/1995	< 0.020	< 0.050	0.594	< 0.002	< 0.005	< 0.002	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	< 0.005
	4/24/1996	< 0.050	0.007	0.13	< 0.010	< 0.010	< 0.010	--	< 0.002	--	< 0.0002	< 0.020	< 0.010	< 0.010
	10/2/1998	--	0.0082	--	--	--	--	17.2	--	0.983	--	--	--	--
	4/13/1999	--	--	--	--	--	--	0.672	--	0.209	--	--	--	--
	7/29/1999	--	--	--	--	--	--	0.165	--	0.058	--	--	--	--
	10/19/1999	--	--	--	--	--	--	1.11	--	0.197	--	--	--	--
MW-3	10/22/1993	< 0.020	< 0.050	0.0091	< 0.002	< 0.005	< 0.002	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	< 0.005
	2/27/1995	< 0.020	< 0.050	0.004	< 0.002	< 0.005	< 0.002	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	0.0132
	4/24/1996	< 0.050	< 0.005	0.010 U	< 0.005	< 0.010	< 0.010	--	< 0.002	--	< 0.0002	< 0.020	< 0.010	< 0.010
	10/2/1998	--	0.0022	--	--	--	--	2	--	0.493	--	--	--	--
	4/13/1999	--	--	--	--	--	--	4.94	--	0.592	--	--	--	--
	7/29/1999	--	--	--	--	--	--	4.82	--	0.595	--	--	--	--
	10/19/1999	--	--	--	--	--	--	3.35	--	0.586	--	--	--	--
MW-4	10/22/1993	< 0.020	0.075	0.126	< 0.002	< 0.005	< 0.002	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	< 0.005
	2/27/1995	< 0.020	< 0.050	0.019	< 0.002	< 0.005	< 0.002	--	< 0.025	--	< 0.0002	< 0.010	< 0.003	0.019
	4/24/1996	< 0.050	< 0.005	0.020	< 0.005	< 0.010	< 0.02	--	< 0.002	--	< 0.0002	< 0.020	< 0.010	0.01
	10/2/1998	--	0.0107	--	--	--	--	45	--	8.05	--	--	--	--
	4/13/1999	--	--	--	--	--	--	0.198	--	0.077	--	--	--	--
	7/29/1999	--	--	--	--	--	--	17.8	--	3	--	--	--	--
	10/19/1999	--	--	--	--	--	--	72.1	--	7.29	--	--	--	--
JSCS (EPA values)		na	0.15	na	0.00094	0.011	0.0029	na	0.00054	na	0.00077	0.016	na	0.0365

Notes:
-- = Compound not included in analysis
JSCS (DEQ values) = Oregon Joint Source Control Strategy Guidance Document, December 2005. DEQ 2004 AWQC for ecological receptors
DEQ Level II SLV = Oregon DEQ Guidance for Ecological Risk Assessment Document, December 2001; Table 1 - Screening Level Values for Aquatic Receptors in Surface water
JSCS (EPA values) = Oregon Joint Source Control Strategy Guidance Document, December 2005: EPA 2004 NRWQC for ecological receptors.
na = not available

TABLE 2
GROUNDWATER ELEVATIONS
TERMINAL 5 UPLAND FACILITY
PORT OF PORTLAND

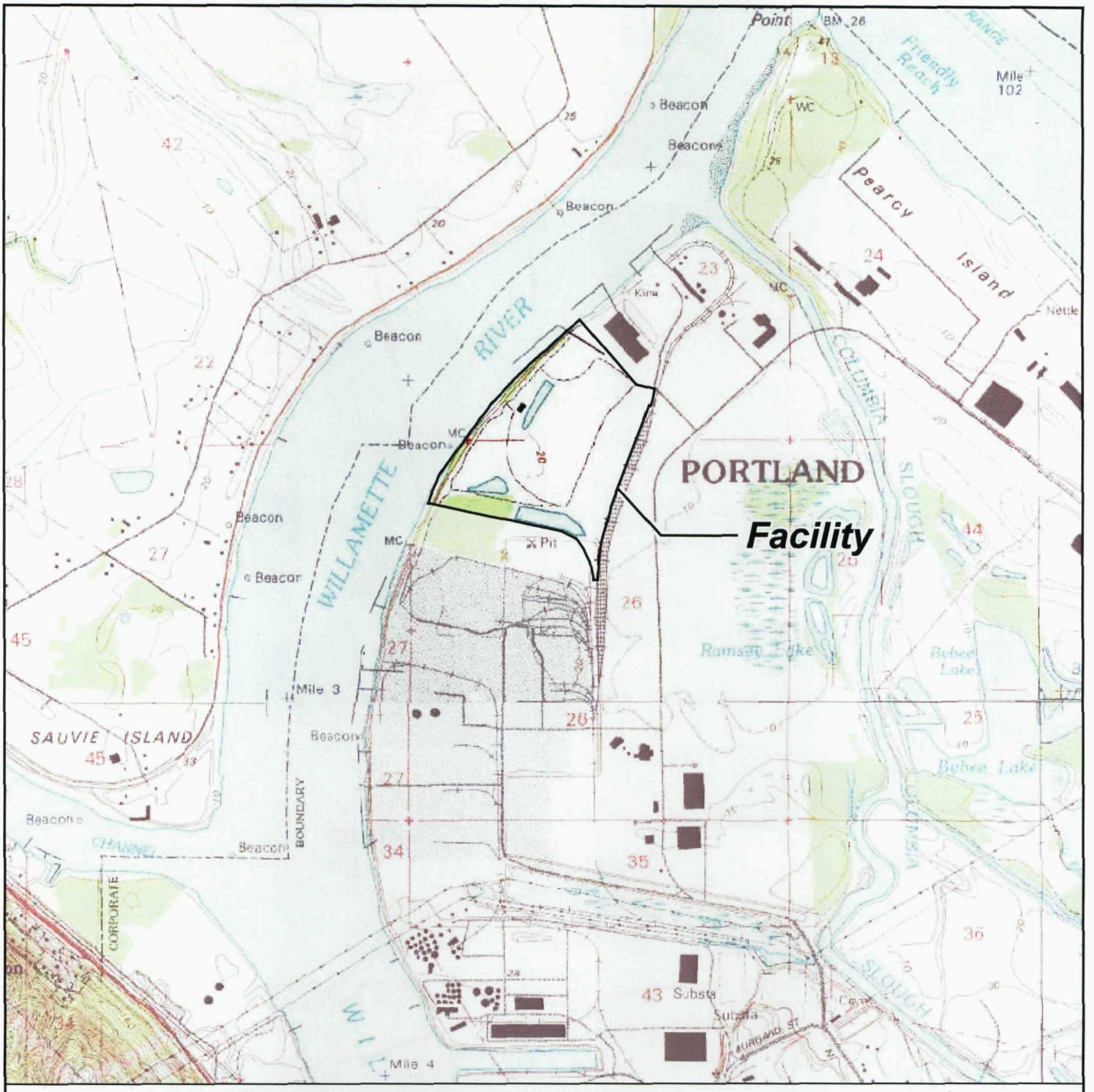
Monitoring Well	Top of Casing Elevation [ft]	Sample Date	Depth to Water [ft]	Groundwater Elevation [ft. MSL]	Field Parameters					
					Temp [°C]	pH	EC [mS/cm]	DO [mg/L]	Turb [NTU]	ORP [mV]
MW-2	39.63	12/14/2005	9.27	30.36	12.76	6.56	0.317	0.06	3.79	-77.8
MW-3	41.17	12/14/2005	10.88	30.29	13.66	6.30	0.181	1.43	1.16	-31.3
MW-4	40.32	12/14/2005	8.10	32.22	12.11	6.10	0.411	2.17	12.3	15.1

Notes:
Field Parameters include Temperature, pH, Electroconductivity, Dissolved oxygen concentration, Turbidity, and Oxidation-reduction potential.

TABLE 3
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS
TERMINAL 5 UPLAND FACILITY
PORT OF PORTLAND

Monitoring Well	Sample Date	Analyte Concentration in mg/L (ppm)					
		Total Recoverable Metals			Dissolved Metals		
		Barium	Iron	Manganese	Barium	Iron	Manganese
MW-2	10/22/1993	2.03	--	--	0.18	--	--
	2/27/1995	0.101	--	--	0.594	--	--
	4/24/1996	1.69	--	--	0.13	--	--
	10/2/1998	0.0641	16.5	0.924	--	17.2	0.983
	4/13/1999	0.0313	2.37	0.293	--	0.672	0.209
	7/29/1999	0.0145	0.85	0.097	--	0.165	0.068
	10/19/1999	0.0236	1.88	0.235	--	1.11	0.197
	12/14/2005	0.095 B	2.8	0.76 B	0.091	3.2 B	0.79 B
MW-3	10/22/1993	0.234	--	--	0.0091	--	--
	2/27/1995	0.0079	--	--	0.004	--	--
	4/24/1996	0.12	--	--	0.010 U	--	--
	10/2/1998	0.0091	3.06	0.506	--	2	0.493
	4/13/1999	0.0185	5	0.608	--	4.94	0.592
	7/29/1999	0.0132	6.95	0.57	--	4.82	0.595
	10/19/1999	0.0105	3.4	0.572	--	3.35	0.586
	12/14/2005	0.012 B	2.7	0.56 B	0.0092	1.7 B	0.48 B
MW-4	10/22/1993	0.949	--	--	0.126	--	--
	2/27/1995	0.0513	--	--	0.019	--	--
	4/24/1996	0.09	--	--	0.020	--	--
	10/2/1998	0.0898	41.6	7.85	--	45	8.05
	4/13/1999	0.0133	1.63	0.084	--	0.198	0.077
	7/29/1999	0.0405	7.97	1.19	--	17.8	3
	10/19/2005	0.0896	71.8	7.4	--	72.1	7.29
	12/14/2005	0.051 B	1.7	0.52 B	0.040	1.0 B	0.49 B
DEQ Aquatic SLV					0.004	1.0	0.12

Notes:
-- = Compound not included in analysis
U = Compound not detected at listed reporting limit.
B = Compound was detected in laboratory blank.
SLV = Oregon DEQ Level II Screening Level Values for Aquatic Surface Water Receptors.



Base map prepared from USGS 7.5-minute quadrangles as provided by Topozone.

0 2000 4000

Scale in Feet

N

Facility Location Map

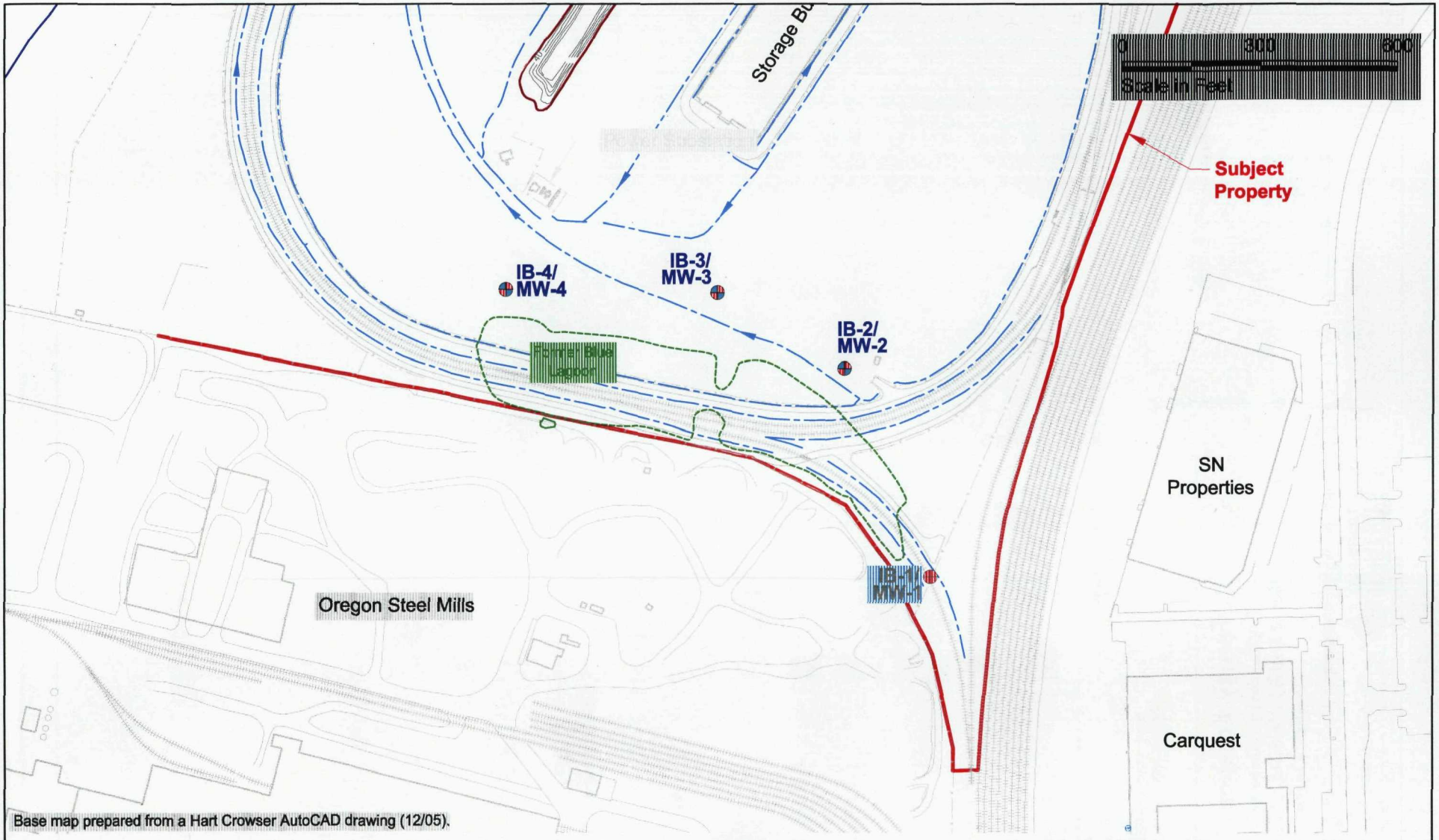
Groundwater Monitoring Report
Port of Portland - Terminal 5 Upland Facility
Portland, Oregon

Project Number	1092-00	January 2006	Figure
			1

NEWFIELDS

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists



Base map prepared from a Hart Crowser AutoCAD drawing (12/05).

Legend:

IB-4/ MW-4 — Investigative Borehole/Monitoring Well Location

⊕ — Abandoned Investigative Borehole/Monitoring Well Location

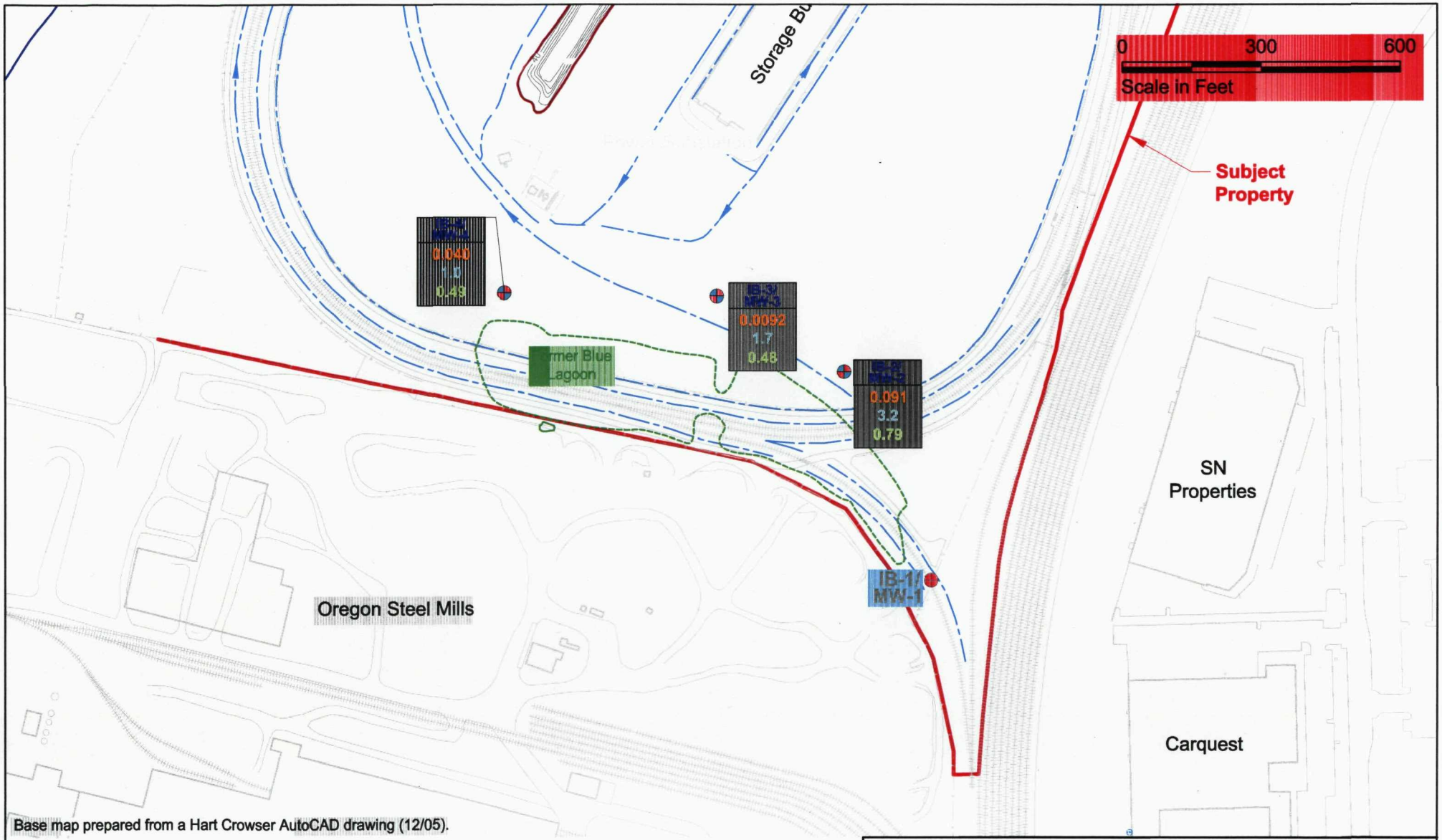
— — — — Ditch

N

Facility Plan

Groundwater Monitoring Report
Port of Portland - Terminal 5 Upland Facility
Portland, Oregon

Project Number	1092-00	January 2006	Figure
NEWFIELDS	Ash Creek Associates, Inc. Environmental and Geotechnical Consultants	BBL Blasland, Bouck & Lee, Inc.	2



Base map prepared from a Hart Crowser AutoCAD drawing (12/05).

Legend:

- IB-4/ MW-4 — Investigative Borehole/Monitoring Well Location
  - 0.040 — Barium Concentration in mg/L
  - 1.0 — Iron Concentration in mg/L
  - 0.49 — Manganese Concentration in mg/L
- IB-1/ MW-1 — Abandoned Investigative Borehole/Monitoring Well Location
- Ditch

N

Groundwater Metals Concentrations (Dissolved)

Groundwater Monitoring Report
Port of Portland - Terminal 5 Upland Facility
Portland, Oregon

Project Number	1092-00	January 2006

NEWFIELDS

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

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engineers, scientists, economists

Figure 4

Appendix A

Sampling and Analysis Plan

1. Introduction

The Port of Portland (Port) was requested to collect groundwater samples from three groundwater monitoring wells at the Terminal 5 Upland Facility (the "Facility"). This Sampling and Analysis Plan (SAP) describes the field sampling procedures and quality assurance/quality control (QA/QC) procedures to be followed during associated field and analytical activities.

1.1 Facility Description and Physical Setting

The Facility is a 173-acre site located on the east bank of the Willamette River (near River Mile 2.0). It is located in the Rivergate Industrial District in north Portland. Adjacent properties include Oregon Steel Mills to the south, Columbia Slough and Kelly Point Park to the north, Union Pacific Railroad and North Lombard Street to the east, and the Willamette River to the west. The Facility has consisted of three tenant properties: a mineral bulk facility leased and operated by Portland Bulk Terminals; a grain terminal leased and operated by Columbia Grain, Inc.; and Alcatel Submarine Networks.

1.2 Key Project Personnel

Key Port, Oregon Department of Environmental Quality (DEQ), and Consultant personnel assigned to this project are listed below.

- Port of Portland Project Manager: Anne Summers
- Port of Portland Assistant Project Manager: Nicole Anderson
- DEQ Project Manager: Tom Gainer
- Consultant Program Manager: Amanda Spencer, Ash Creek Associates
- Consultant Site Manager: Amanda Spencer, Ash Creek Associates
- Consultant Field Manager: Brooke Miller, BBL
- Consultant Quality Assurance Manager: Mike Stevens, Ash Creek Associates
- Consultant Health and Safety Manager: Mike Stevens, Ash Creek Associates

1.3 Contractor Services

The scope of work of this SAP requiring subcontractor services will include:

- Investigation-derived waste (IDW) disposal (Terra Hydr); and
- Laboratory analysis (Severn Trent Laboratories).

2. Field and Sampling Procedures

The scope of work includes measuring water elevations and performing groundwater monitoring. The field and sampling procedures include the following:

- Measurement of water levels in monitoring wells;
- Collection of groundwater samples from monitoring wells;

- Sample management (e.g., containers, storage, and shipment);
- Decontamination procedures; and
- Handling of IDW.

2.1 Measurement of Water Levels in Monitoring Wells

Water levels in the wells will be measured and recorded for the purpose of determining the groundwater gradient and elevations. The wells will be opened and the water level allowed to equilibrate before the measurements are taken. The measurements will be made to the nearest 0.01 foot using an electronic probe. Water levels will be measured in wells MW-2 through MW-4.

2.2 Collection of Groundwater Samples from Monitoring Wells

Groundwater monitoring will consist of collecting groundwater samples and measuring groundwater field parameters. Groundwater samples will be collected from the wells MW-2 through MW-4.

Materials. The following materials shall be available during groundwater sampling:

- Sample pump (downhole pump, based on expected depth to groundwater)
- Sample tubing
- Power source (i.e., battery pack or generator)
- Appropriate health and safety equipment as specified in the Health and Safety Plan (HASP)
- Plastic sheeting (for each sampling location)
- Dedicated or disposable bailers
- New disposable polypropylene rope
- Buckets to measure purge water
- Water level probe or oil/water interface probe as appropriate
- 6-foot rule with gradation in hundredths of a foot
- Conductivity/temperature meter
- pH meter
- Oxidation-reduction potential (ORP) meter
- Appropriate water sample containers (Section 3.0)
- Appropriate blanks (trip blank supplied by the laboratory)
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials
- Groundwater sampling logs
- Chain of custody forms
- Indelible ink pens
- Site map with well locations and groundwater contour maps
- Keys to wells

Sampling. The procedures to sample monitoring wells will be as follows:

Step 1. Review materials list (above) to ensure the appropriate equipment has been acquired.

Step 2. Identify site and well sampled, along with date, arrival time, and weather conditions. Identify the personnel and equipment utilized and other pertinent data requested on the logs.

Step 3. Label all sample containers using the laboratory-supplied label.

Step 4. Don safety equipment, as required in the HASP.

Step 5. Place plastic sheeting adjacent to the well to use as a clean work area.

Step 6. Remove the lock from the well and, if rusted or broken, replace with a new brass keyed-alike lock.

Step 7. Unlock and open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting.

Step 8. Set out on plastic sheeting the dedicated or disposable sampling device and meters.

Step 9. Prior to sampling, measure groundwater elevations at each monitoring well and evaluate the presence of non-aqueous phase liquid [NAPL] (if any) within the well. Obtain a water level depth and bottom of well depth using an electric well probe and record on sampling log sheet. Clean the well probe after each use with a soapy (Alconox) water wash and a tap water rinse. [Note: water levels will be measured at all wells prior to initiating a sampling event].

Step 10. After groundwater elevations are measured and NAPLs are determined not to be present, purge groundwater from the wells. Dispose of purge water properly (described in Section 2.11).

Step 11. Slowly lower the pump tubing into the well to a depth corresponding to the center of the saturated screen section of the well (keep the pump intake at least 2 feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well).

Step 12. Measure the water level again with the pump in the well before starting the pump. Start pumping the well at 200 to 500 milliliters per minute (ml/min). Ideally, the pump rate should cause little or no water level drawdown in the well (less than 0.3 foot and the water level should stabilize). Monitor the water level every 3 to 5 minutes (or as appropriate) during pumping. Care should be taken not to cause pump suction to be broken or entrainment of air in the sample. Record pumping rate adjustments and depths to water. If needed, reduce pumping rates to the minimum capabilities of the pump to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low, interrupt purging so as not to cause the drawdown within the well to advance below the pump. However, maintain a steady flow rate to the extent practicable. Commence sampling as soon as the volume in the well has recovered sufficiently to permit collection of samples.

Step 13. During purging of the well, monitor the field indicator parameters (specific conductance, pH, and temperature). The well is considered ready for sample collection once the field indicator parameter values are stable for three consecutive readings. Stable values are defined as:

- Specific conductance: +/- 3% S/cm
- pH: +/- 0.1 pH units
- Temperature: +/- 1 degree C.

Step 14. Fill in the sample label and cover the label with clear packing tape to secure the label to the container.

Step 15. After the appropriate purge volume of groundwater in the well has been removed and field parameter measurements have stabilized, obtain the groundwater sample needed for analysis directly from the sampling device in the appropriate container and tightly screw on the caps.

Step 16. Secure with packing material and store at 4°C on wet ice in an insulated transport container provided by the laboratory.

Step 17. After all sampling containers have been filled, remove an additional volume of groundwater. Check the calibration of the meters and then measure and record on the field log physical appearance, pH, temperature, ORP turbidity, and conductivity.

Step 18. Record the time sampling procedures were completed on the field logs.

Step 19. Place all disposable sampling materials (plastic sheeting, disposable bailers, and health and safety equipment) in appropriately labeled containers. Go to the next well and repeat Step 1 through Step 19 until all wells are sampled.

Step 20. Complete the procedures for packaging, shipping, and handling with associated chain of custody.

Alternative methods may be used if approved by the project manager prior to implementation.

Field Quality Control. The following quality control procedures should be observed in the field:

- Collect samples from monitoring wells in order of increasing concentration, to the extent known;
- Equipment blanks should include the pump and tubing (if using disposable tubing) or the pump only (if using tubing dedicated to each well);
- Collect equipment blanks after wells with higher concentrations (if known) have been sampled; and
- Operate all monitoring instrumentation in accordance with manufacturer's instructions and calibration procedures. Instruments should be calibrated at the beginning of the sampling event.

Equipment Cleaning. All groundwater sampling equipment should be cleaned prior to use in the first well and after each subsequent well.

Duplicate Sample. For QA/QC purposes, a duplicate sample will be collected from one well for chemical analysis. Alternately fill sample containers for the primary and duplicate samples with water from the well.

2.3 Sample Handling, Chain of Custody, and Receipt

Sample documentation is a critical aspect of environmental investigations. Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to the time sample results are potentially introduced as evidence. A sample log form and field logbook entries will be completed for each location occupied and each sample collected.

2.3.1 Sample Containers, Preservation, and Holding Time Requirements

Pre-cleaned certified sample containers, which will be provided by the contract analytical laboratory, must be used for all samples that will be analyzed by the analytical laboratory. Specific types and sizes of containers for each parameter, as well as holding time and preservation requirements, are listed in Table A-1.

Sample containers for chemical analyses will be cleaned to USEPA protocols. Certifications attesting to the cleanliness of pre-cleaned containers are required for containers used for organic analyses and will be maintained in the project file. Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice (see below) and carefully packed to eliminate the possibility of container breakage.

2.3.2 Sample Packing, Handling, and Shipping

Sample packaging and shipment procedures are designed to ensure that the samples will arrive at the laboratory with the chain of custody (COC) intact. Samples will be packaged for shipment as outlined below.

1. Ensure that sample labels are securely affixed to sample containers with clear packing tape.
2. Check the caps on the sample containers to ensure that they are properly sealed.
3. Wrap sample container caps with clear packing tape to prevent them from loosening.
4. Complete the COC form with the required sampling information and ensure that the recorded information matches the sample labels. NOTE: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC prior to this transfer. The appropriate personnel will sign and date the COC form to document the sample custody transfer. If multiple coolers are shipped at one time, a separate COC should be prepared for each cooler.
5. Using duct tape, secure the outside drain plug at the bottom of the cooler (if present).
6. Wrap sample containers in bubble wrap or other cushioning material.
7. Place 1 to 2 inches of cushioning material at the bottom of the cooler.
8. Place the sealed sample containers and a temperature blank in the cooler.
9. Place ice in plastic bags and seal. Place the ice-filled bags loosely in the cooler.
10. Fill the remaining space in the cooler with cushioning material.
11. Place COC forms in plastic bags and seal. Tape the forms to the inside of the appropriate cooler lid.
12. Close the cooler lid and secure with duct tape.
13. Wrap strapping tape around both ends of the cooler at least twice.
14. If the cooler is to be shipped by service or courier, mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels, and arrows indicating "this side up." Cover the labels with clear plastic tape. Place a signed custody seal over the cooler lid.

Samples will be packaged by the field personnel and transported as low-concentration environmental samples. The samples will be delivered by an express carrier within 48 hours of the time of collection with the possible exception of some Friday samples and the exception of Saturday samples. For all samples taken on Fridays, the field crew will verify with the laboratory by telephone whether laboratory personnel are available to receive samples on Saturday. If laboratory personnel are not available, samples will be held within the required temperature range and shipped on the following Monday. Samples collected on Saturday will be held within the required temperature range and shipped on the following Monday. Shipments will be accompanied by the COC form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the COC form as long as the forms are sealed inside the sample coolers and the custody seals remain intact.

2.3.3 Sample Receipt

All samples received at the laboratory will be carefully checked for label identification and complete, accurate COC documentation. The condition of the samples will be checked, and the temperature blank will be measured and recorded (with a calibrated digital thermometer) immediately after the cooler is opened. These results, along with any questions or comments regarding sample integrity, will be recorded on the COC form (or appropriate laboratory cooler receipt form). The laboratory will contact the Consultant site manager immediately if discrepancies between the samples and COC records are found upon receipt. If it is necessary for the receiving laboratory to ship samples to other laboratories, the COC form will be completed and will accompany the samples. A copy of the COC form (and cooler receipt form) will be faxed to the Consultant site manager and included in the final analytical data report.

Once received at the laboratory, the samples will be maintained at 4 ± 2 °C, unless it is required that the samples be held at a lower temperature (not less than -20 ± 10 °C) to extend their holding time.

If a sample container is received broken, if a sample is received in an inappropriate container, or if a sample has not been preserved by appropriate means, the laboratory will notify the Consultant site manager. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling each sample bottle with its laboratory identification number, and moving the samples to appropriate storage locations to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

2.4 Decontamination Procedures

Personnel Decontamination. Personnel decontamination procedures depend on the level of protection specified for a given activity. The HASP identifies the appropriate level of protection for the type of work and expected field conditions involved in this project. In general, clothing and other protective equipment can be removed from the investigation area. Field personnel should thoroughly wash their hands and faces at the end of each day and before taking any work breaks.

Sampling Equipment Decontamination. To prevent cross contamination between sampling events, clean, dedicated sampling equipment (e.g., groundwater sampling tubing) will be used for each sampling event and will be discarded after use. Cleaning of non-disposable items will consist of washing in a detergent (Alconox®) solution, rinsing with tap water, followed with a deionized water rinse.

To reduce the chance for cross contamination between soil borings, the drilling equipment will be cleaned with a high-pressure washer before and after each well installation. Decontamination water will be collected and handled in accordance with Section 2.5.

2.5 Handling of Investigation-Derived Waste

IDW may be generated from well sampling activities. IDW may include purge water, decontamination water, and discarded personal protective supplies. Generated water will be collected in DOT-approved 55-gallon drums and stored at a designated area of the East Parcel pending characterization and disposal.

Water will be designated based on the results of the submitted groundwater samples. Based on prior activity at the Facility, it is anticipated that the water will be disposed of at a local oil recycling facility. Disposal will be completed by a subcontractor.

Other wastes, such as used personal protective equipment and trash will be collected and disposed of in a waste receptacle.

3. Analytical Testing Program

An analytical testing program will be performed to assess the chemical quality of groundwater samples collected as part of this project. Analytical laboratory QA/QC procedures are discussed in Section 4.

Table A-2 lists the proposed analytical methods and detection limit goals. The listed detection limit goals are the lowest levels that can be practicably attained.

Table A-3 summarizes the rationale for analyses and the anticipated number of groundwater samples. Table A-4 summarizes the same information for quality control samples (duplicates and field blanks). Samples will be collected and handled using methods described in Section 2 of this appendix.

3.1 Groundwater Samples

Monitoring Well Samples. Collected groundwater samples will be submitted to the analytical laboratory for analysis of metals (barium, iron, and manganese) by EPA Method 6020.

IDW. The IDW water will be characterized based on the results of the monitoring well sample analyses; no additional analyses will be performed.

4. Quality Assurance Procedures

4.1 Preventive Maintenance

Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call to the manufacturer.

Maintenance schedules for laboratory equipment will adhere to the manufacturers' recommendations. Records will reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures will be performed through service contracts with manufacturers or qualified contractors. Paperwork associated with service calls and preventive maintenance calls will be kept on file by the laboratory.

Laboratory Systems Managers are responsible for the routine maintenance of instruments used in a particular laboratory. Any routine preventive maintenance carried out is logged into the appropriate logbooks. Routine and non-routine maintenance schedules and procedures will be performed in accordance with the laboratory's quality assurance manual.

All major instruments will be backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts will also be available to minimize equipment/instrument downtime.

4.2 Calibration Procedures and Frequency

When analyses are conducted according to USEPA methods, the calibration procedures and frequencies specified in the applicable method will be followed. For analyses governed by SOPs, see the appropriate

laboratory SOP for the required calibration procedures and frequencies. Records of calibrations will be filed and maintained by the laboratory. These records will be subject to QA audit. For all instruments, the laboratory will maintain trained repair staff and in-house spare parts or will maintain service contracts with vendors.

All standards used in the calibration of equipment will be traceable, directly or indirectly, to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable, commercial sources. All standards received shall be logged into standard receipt logs maintained by the individual analytical groups. Each group shall maintain a standards log that tracks the preparation of standards used for calibration and QC purposes.

4.3 Laboratory QC Requirements

4.3.1 Quality Assurance Indicators

The overall quality assurance objective of this quality control plan is to develop and implement procedures for sampling, COC, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, audits, preventive maintenance, and corrective action such that valid data will be generated. These procedures are presented or referenced in the following sections. Specific QC checks are discussed in Section 4.5.

Quality assurance indicators are generally defined in terms of five parameters:

- Precision;
- Accuracy;
- Representativeness;
- Comparability; and
- Completeness.

Each parameter is defined below. Specific objectives for this project are set forth in other sections as referenced below.

4.3.2 Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work will adhere to established protocols presented herein. Analytical precision will be measured through matrix spike/matrix spike duplicates (MS/MSDs) and laboratory control sample/laboratory control sample duplicates (LCS/LCSDs) for organic analyses and through laboratory duplicate samples for inorganic analyses. Analytical precision measurements will be carried out on project specific samples at a minimum frequency of one per laboratory analysis group or one in 20 samples, whichever is more frequent, per matrix analyzed. Laboratory precision will be evaluated against laboratory control limits established under the USEPA method for that analysis.

The equation used to express precision is:

$$RPD = \frac{(A-B)}{(A-B)/2} \times 100\%$$

Where:

A = Analytical result from one of two duplicate measurements

B = Analytical result from the second measurement

Precision will generally be evaluated against laboratory control limits. Precision measurements can be affected by how close a chemical concentration is to the reporting limit, which can increase the percent error (expressed as RPD). When a sample or duplicate concentration is within five times the reporting limit, alternative control limits recommended by the USEPA (1999, 2002) of +/- the reporting limit for water samples and two times +/- the reporting limit for soil samples will be used.

4.3.3 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, matrix spikes, blank spikes, laboratory control samples, and surrogate standards will be used to assess the accuracy of the analytical data. Accuracy measurements on MS samples will be carried out at a minimum frequency of one in 20 samples per matrix analyzed. Because MS/MSDs measure the effects of potential matrix interferences for a specific matrix, the laboratory will perform MS/MSDs only on project-specific samples. Surrogate recoveries will be determined for every sample analyzed for organics.

Laboratory accuracy will be evaluated against laboratory control limits established under the USEPA method for that analysis. Accuracy can be expressed as a percentage of the true or reference value or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is:

$$\%Recovery = \frac{A - X}{B} \times 100\%$$

Where:

A = Value measured in spiked sample or standard

X = Value measured in original sample

B = True value of amount added to sample or true value of standard

4.3.4 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent conditions in the media being sampled. Representativeness is dependent on sampling and analytical variability and the variability of environmental media. The sampling program has been designed to assess the presence of the chemical constituents at the time of sampling and presents the rationale for sample quantities and sampling locations. In addition, the use of the prescribed field and laboratory analytical methods, with their associated holding times and preservation requirements, is intended to provide representative data.

4.3.5 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability will be maintained through consistent use of the sampling and analytical methodologies set forth herein and through the use of established QA/QC procedures and appropriately trained personnel.

4.3.6 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. Completeness will be calculated as follows:

C = [(number of acceptable data points) x 100]/(total number of data points collected)

The data quality objective for completeness for all components of this project is 100%. Data qualified as estimated because the quality control criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

4.4 Field Quality Control Checks

Field QC samples will be analyzed to identify possible problems resulting from sample collection or sample processing in the field. All field QC samples will be documented in the field logbook and verified by the Consultant QA Manager or designee.

4.4.1 Field Duplicates

A minimum of one field duplicate will be collected per 10 samples submitted for analysis.

4.5 Analytical Laboratory Quality Control Checks

Internal laboratory quality control checks will be used to monitor data integrity. These checks will include method blanks, MSs (and MSDs), LCSs (and LCSDs), spike blanks, internal standards, surrogate samples, calibration standards, and reference standards. Laboratory control limits will be used to evaluate MS/MSD, LCS/LCSD, and surrogate recoveries. Laboratory control charts will be used to determine long-term instrument trends.

Results of QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits have been exceeded. If control limits are exceeded in the sample group, the Consultant QA Manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing of the affected samples) will be initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in a standard will be documented.

4.5.1 Method Blanks

Sources of contamination in the analytical process, whether specific analyses or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank be initiated at the beginning of the analytical process and encompass all aspects of the analytical work so that the method blank can assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources.

One method blank will be analyzed with each analytical series associated with no more than 20 samples.

4.5.2 Laboratory Control Samples

Laboratory control samples will be used; they will be developed and spiked by the laboratory or laboratory standards will be used.

4.5.3 Matrix Spike/Matrix Spike Duplicate

Site-specific MS/MSDs will be used to measure the accuracy of analyte recovery from the sample matrices. Matrix spike duplicate pairs will be analyzed at a frequency of 5% (every 20 samples or once every week, whichever comes first).

When MS recoveries are outside QC limits, associated control sample and surrogate spike recoveries will be evaluated, as applicable, to attempt to verify the reason for the deviation and determine the effect on the reported sample results.

4.5.4 Surrogate Spikes

Surrogates are compounds that are unlikely to occur under natural conditions and that have properties similar to the analytes of interest. Surrogates are added to the samples prior to purging or extraction and are primarily used for organic samples analyzed by gas chromatography/mass spectrometry and gas chromatography methods. The surrogate spike provides broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to sample matrix. All project samples analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined in the analytical methods.

If surrogate spike recoveries exceed specified QC limits, then the analytical results will be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures, the integrity of the data may not be verifiable and reanalysis of the samples with additional control may be necessary.

Surrogate spike compounds will be selected on the basis of guidance provided in the analytical methods.

4.5.5 Laboratory Duplicates

For inorganic analyses, laboratory duplicates will be analyzed to assess laboratory precision. A laboratory duplicate is defined as a separate aliquot of an individual sample that is analyzed as a separate sample.

4.5.6 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding instrument stability. A calibration check standard will be analyzed at the beginning and end of an analytical series or periodically throughout a series that contains a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours or more frequently, as specified in the applicable analytical method. If results of the calibration check standard exceed specified tolerances, then samples analyzed since the last acceptable calibration check standard will be reanalyzed.

4.5.7 Reference Standards/Control Samples

Reference standards are standards of known concentration and are independent in origin from the calibration standards. Reference standard analysis provides insight into analytical proficiency within an analytical series, including the preparation of calibration standards, the validity of calibration, sample preparation, instrument setup, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods.

For samples that are analyzed for metals by graphite furnace, an analytical spike will be analyzed after each sample analysis.

5. Data Management

All data will undergo two levels of QA/QC evaluation: one at the laboratory and one by a qualified independent data validator. Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols and the laboratory's QA manual. Quality control data resulting from methods and procedures described in this document will also be reported.

5.1 Sample Management

All laboratory analytical batches will be assigned a unique number and tracking identifier at the laboratory. All data reports will include this tracking number. The laboratory will use a Laboratory Information Manager system to track all samples throughout the analytical stream.

5.2 Data Reporting

Analytical chemistry results will be provided by the laboratory in both digital and hard-copy formats. Upon receipt of each analytical package, the original COC form will be placed in the project files. The data packages will be examined to ensure that the correct analyses were performed for each sample submitted and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the Consultant QA Manager will be notified and will promptly follow up with the laboratory to resolve any issues.

Any data that do not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following completion of data validation, the digital files will be used to generate the appropriate report tables. The format for the electronic data deliverable (EDD) specifies one data record for each constituent for each sample analyzed. Specific fields include:

- Sample identification number;
- Date sampled;
- Date analyzed;
- Parameter name;
- Analytical result;
- Units;
- Detection limit; and
- Qualifier(s).

The individual EDDs, which will be supplied by the laboratory in either an ASCII comma-separated value format or in a Microsoft Excel worksheet, will be loaded into the appropriate database. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually. After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

5.3 Data Management Procedures

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to ensure the validity of the data. To effectively execute such documentation, carefully constructed sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms, as described in Section 2.9. Copies of all completed COC forms will be maintained in the field office. The laboratory shall verify receipt of the samples electronically (via fax) on the following day.

When analytical data are received from the laboratory, the Consultant site manager will review the incoming analytical data packages against the information on the COCs to confirm that the correct analyses were performed for each sample and that results were received for all samples submitted for analysis. Any discrepancies noted will be promptly followed up by the Consultant site manager.

5.3.1 Laboratory Turnaround Time

All chemical analytical work will be completed within 15 business days of sample receipt or earlier if necessary to meet holding times.

6. Data Assessment Procedures

Once the data are received from the laboratory, a number of QC procedures will be followed to accurately evaluate data quality and assess data precision, accuracy, and completeness.

6.1 Data QC Review

Chemistry data will be subject to multilevel review by the analytical laboratory. The group leader will review all data reports prior to their release for final data report generation. The QA Manager will review the final data reports, and the Laboratory Project Manager will review a cross section of the final data reports prior to shipment. If discrepancies or deficiencies exist in the analytical results, then corrective action will be taken, as discussed in Section 7. The deficiencies and the corrective actions will be documented on a Corrective Action Form. This form will be submitted to the Consultant QA Manager.

6.2 Data Evaluation and Verification

The project manager will ensure validation of the analytical data. The laboratory generating analytical data for this project will be required to submit results that are supported by sufficient backup and QA/QC data to enable the reviewer to determine the quality of the data. Validity of the laboratory data will be determined based on the project objectives. Data validity will also be determined based upon the sampling procedures and documentation. Upon completion of the review, the project manager will be responsible for assuring development of a QA/QC report on the analytical data. All data will be stored and maintained according to the standard procedures of the laboratory. The method of data reduction will be described in the final report.

7. Laboratory Audits and Corrective Actions

Laboratory and field performance audits and corrective action procedures are described in this section.

7.1 Laboratory and Field Performance Audits

Laboratory and field performance audits consist of on-site reviews of QA systems and equipment for sampling, calibration, and measurement. Laboratory audits will not be conducted for this project; however, all laboratory audit reports will be made available to the Consultant QA Manager upon request. All laboratories are required to have written procedures addressing internal QA/QC; these procedures will be reviewed by the Consultant QA

Manager to ensure compliance with this QA/QC Plan. All laboratories must ensure that personnel engaged in sampling and analysis tasks have appropriate training. The laboratory will, as part of the audit process, provide written details of any and all planned modifications for review.

7.2 Corrective Action Procedures

7.2.1 Corrective Action for Field Sampling

The Field Manager will be responsible for correcting equipment malfunctions during the field sampling effort. The Consultant QA Manager will be responsible for resolving situations in the field that may result in noncompliance with this plan. All corrective measures will be immediately documented in the field logbook.

7.2.2 Corrective Action for Laboratory Analyses

The laboratory is required to submit and comply with its SOPs. The Laboratory Project Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this plan. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

The Consultant QA Manager will be notified immediately if any QC sample exceeds the laboratory control limits. The analyst will identify and correct the anomaly before continuing with the sample analysis. The Laboratory Project Manager will document the corrective action taken in a memorandum submitted to the Consultant QA Manager within five days of the initial notification. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, reextraction) will be submitted with the data package in the form of a cover letter.

TABLE A-1
ANALYTICAL METHODS
TERMINAL 5 UPLAND FACILITY
PORT OF PORTLAND

Analysis	Method	Container	Preservative	Storage Temperature	Holding Time
Groundwater Samples					
Metals	EPA 6000/7000	1 250 mL Poly	HNO_3	4°C	180 days

Note:
1. The number of required sample containers will be determined and supplied by the analytical laboratory. Some analytical sample aliquots may be taken from the same container.

Acronyms:
HNO_3: Nitric Acid

TABLE A-2
DETECTION LIMITS
TERMINAL 5 UPLAND FACILITY
PORT OF PORTLAND

Method and Analyte	Groundwater (mg/L)
Metals by EPA Method 6000/7000	
Barium	0.0025
Iron	0.0050
Manganese	0.0025

TABLE A-3
ANTICIPATED SAMPLE NUMBER AND ANALYSIS
TERMINAL 5 UPLAND FACILITY
PORT OF PORTLAND

Sample Matrix	Sample Type	Analyses Requested	Anticipated Number of Samples*	Comments
Groundwater	Monitoring Well	Metals	3	3 wells, one event.

Note:
1. *Does not include QA samples from Table A-4.

TABLE A-4
QUALITY ASSURANCE SAMPLES
TERMINAL 5 UPLAND FACILITY
PORT OF PORTLAND

QA Sample Matrix	QA Sample Type	Analyses Requested	Anticipated Number of Samples	Comments
Groundwater	Duplicate	Metals	1	One per groundwater sampling event

Appendix B

Field Sampling Sheets

TS
Site

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

TS GW development
Event

GROUND-WATER SAMPLING LOG

Sampling Personnel: JRS
Job Number: 400
Weather: overcast ~40°F

Well ID: TS-MW-2
Date: 12/12/05
Time In: 12:30 Time Out:

WELL INFORMATION

		TIC	TOC	BGS
Well Depth	(feet)		23.30	
Water Table Depth	(feet)		9.16	

check where appropriate

Well Type: Flushmount ☐ Stick-Up ☒
Well Locked: Yes ☒ No ☐
Measuring Point Marked: Yes ☒ No ☐
Well Diameter: 1" ☐ 2" ☒ Other: ____

WELL WATER INFORMATION

Length of Water Column:	(feet)	14.14
Volume of Water in Well:	(gal)	2.30
Pumping Rate of Pump:	(mL/min)	~750
Pumping Rate of Pump:	(GPM)	0.3
Minutes of Pumping:	(min)	~45
Total Volume Removed:	(gal)	14 gal

Conversion Factors

gallons per foot of water column:	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L = 3785 mL = 0.1337 cubic ft.

Unit Stability

pH	DO	Cond	ORP
± 0.1	± 10%	± 3.0%	± 10 mV

SAMPLING INFORMATION

Analyses:

TCL VOCs	☐
TCL SVOCs	☐
Tal Inorganics (inc. Cyanide) - Total	☐
Tal Inorganics (inc. Cyanide) - Dissolved	☐
TCL PCBs - Total	☒
TCL PCBs - Dissolved	☐

Sample ID: ____
Sample Time: ____
MS/MSD: Yes ☐ No ☐
Duplicate: Yes ☐ No ☐
Duplicate ID: ____
Total Bottles: ____

EVACUATION INFORMATION

Evacuation Method:	Bailer ☐	Peristaltic ☐	Grundfos ☒	Other Pump ☐	____
Tubing Used:	Teflon ☒	Polyethylene ☐			
Sampling Method:	Bailer ☐	Peristaltic ☐	Grundfos ☒	Other Pump ☐	____

Did well go dry? Yes ☐ No ☒ Water Quality Meter Type: YSI 6920 w/ 650 MDS w/ flow through cell

Time / Parameter	1 13:00 Initial	2 13:05	3 13:10	4 13:13	5	6	7	8	9
Volume Purged (ml)	8 gal	9 gal	11 gal	14 gal					
Depth to Water (ft. TIC)	9.15	9.15	9.17	9.09					
Temperature (°C)	12.95	13.04	13.57	13.53					
pH	6.66	6.72	6.72	6.73					
Conductance (mS/cm)	0.369	0.394	0.394	0.415					
Dissolved Oxygen (mg/L)	48.2	43.1	43.1	43.1					
Turbidity (NTU)	—	280	100	45					
ORP (mV)	-46.0	-65.6	-70.6	-77.3					

Time / Parameter	10	11	12	13	14
Volume Purged (ml)					
Depth to Water (ft. TIC)					
Temperature (°C)					
pH					
Conductance (mS/cm)					
Dissolved Oxygen (mg/L)					
Turbidity (NTU)					
ORP (mV)					

MISCELLANEOUS OBSERVATIONS/PROBLEMS

SAMPLE DESTINATION

Laboratory: ____ Sample was ☐ shipped day of sampling ☐ sent on ____ Chain of Custody Signed By: ____
Shipped Via: ☐ Federal Express ☐ Other: ____

T5 — Site

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

TS GW development — Event

GROUND-WATER SAMPLING LOG

Sampling Personnel: JRS
Job Number:
Weather: OVERCAST ~45°F

Well ID: TS MW-3
Date: 12/12/05
Time In: 13:49 Time Out:

WELL INFORMATION

		TIC	TOC	BGS
Well Depth	(feet)		20.32	
Water Table Depth	(feet)		10.85	

check where appropriate
Well Type: Flushmount ☐ Stick-Up ☒
Well Locked: Yes ☒ No ☐
Measuring Point Marked: Yes ☒ No ☐
Well Diameter: 1" ☐ 2" ☒ Other:

WELL WATER INFORMATION

Length of Water Column:	(feet)	9.45
Volume of Water in Well:	(gal)	1.54
Pumping Rate of Pump:	(mL/min)	~1200
Pumping Rate of Pump:	(GPM)	~0.4
Minutes of Pumping:	(min)	~35
Total Volume Removed:	(gal)	13 gal

Conversion Factors

gallons per foot of water column	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L = 3785 mL = 0.1337 cubic ft.

Unit Stability

pH	DO	Cond	ORP
± 0.1	± 10%	± 3.0%	± 10 mV

SAMPLING INFORMATION

Analyses:
TCL VOCs ☐
TCL SVOCs ☐
Tal Inorganics (inc. Cyanide) - Total ☐
Tal Inorganics (inc. Cyanide) - Dissolved ☐
TCL PCBs - Total ☐
TCL PCBs - Dissolved ☐
Sample ID:
Sample Time:
MS/MSD: Yes ☐ No ☐
Duplicate: Yes ☐ No ☐
Duplicate ID:
Total Bottles:

EVACUATION INFORMATION

Evacuation Method: Bailer ☐ Peristaltic ☐ Grudfos ☒ Other Pump ☐
Tubing Used: Teflon ☒ Polyethylene ☐
Sampling Method: Bailer ☐ Peristaltic ☐ Grudfos ☒ Other Pump ☐

Did well go dry? Yes ☐ No ☒ Water Quality Meter Type: YSI 6920 w/ 650 MDS w/ flow through cell

Time / Parameter	1 13:57 (initial)	2 14:05	3 14:09	4 14:13	5	6	7	8	9
Volume Purged (gal)	6 gal	9.5 gal	12 gal	13 gal					
Depth to Water (ft. TIC)	11.10	11.10	11.10	11.10					
Temperature (°C)	14.69	15.15	15.22	15.29					
pH	6.57	6.43	6.42	6.42					
Conductance (mS/cm)	0.176	0.177	0.181	0.184					
Dissolved Oxygen (mg/L)	45.1	44.1	44.1	44.1					
Turbidity (NTU)	45	27.6	10.03	8.90					
ORP (mV)	-14.6	-18.9	-22.7	-26.4					

Time / Parameter	10	11	12	13	14
Volume Purged (ml)					
Depth to Water (ft. TIC)					
Temperature (°C)					
pH					
Conductance (mS/cm)					
Dissolved Oxygen (mg/L)					
Turbidity (NTU)					
ORP (mV)					

MISCELLANEOUS OBSERVATIONS/PROBLEMS

SAMPLE DESTINATION

Laboratory:
Shipped Via: ☐ Federal Express ☐ Other:
Sample was ☐ shipped day of sampling ☐ sent on
Chain of Custody Signed By:

TS
Site

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

TS GW Development
Event

GROUND-WATER SAMPLING LOG

Sampling Personnel: JRS
Job Number:
Weather: overcast ~45°F

Well ID: TS MW-4
Date: 12/12/05
Time In: 14:35 Time Out:

WELL INFORMATION

		TIC	TOC	BGS
Well Depth	(feet)		23.60	
Water Table Depth	(feet)		7.73	

check where appropriate

Well Type: Flushmount ☐ Stick-Up ☒
Well Locked: Yes ☒ No ☐
Measuring Point Marked: Yes ☒ No ☐
Well Diameter: 1" ☐ 2" ☒ Other:

WELL WATER INFORMATION

Length of Water Column:	(feet)	15.87
Volume of Water in Well:	(gal)	2.58
Pumping Rate of Pump:	(mL/min)	~750
Pumping Rate of Pump:	(GPM)	~.3
Minutes of Pumping:	(min)	~35
Total Volume Removed:	(gal)	9 gal

Conversion Factors

gallons per foot of water column	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L = 3785 mL = 0.1337 cubic ft.

Unit Stability

pH	DO	Cond	ORP
± 0.1	± 10%	± 3.0%	± 10 mV

EVACUATION INFORMATION

Evacuation Method: Bailer ☐ Peristaltic ☐ Grudfos ☒ Other Pump ☐
Tubing Used: Teflon ☒ Polyethylene ☐
Sampling Method: Bailer ☐ Peristaltic ☐ Grudfos ☒ Other Pump ☐

Did well go dry? Yes ☐ No ☒ Water Quality Meter Type: YSI 6920 w/ 650 MDS w/ flow through cell

SAMPLING INFORMATION

Analyses:
TCL VOCs ☐
TCL SVOCs ☐
Tal Inorganics (inc. Cyanide) - Total ☐
Tal Inorganics (inc. Cyanide) - Dissolved ☐
TCL PCBs - Total ☐
TCL PCBs - Dissolved ☐
Sample ID:
Sample Time:
MS/MSD: Yes ☐ No ☐
Duplicate: Yes ☐ No ☐
Duplicate ID:
Total Bottles:

Time / Parameter	1 14:52 initial	2 14:56	3 15:00	4	5	6	7	8	9
Volume Purged (ml)	6 gal	7.5 gal	9 gal						
Depth to Water (ft. TIC)	12.76	13.07	13.20						
Temperature (°C)	14.58	14.87	14.98						
pH	6.62	6.27	6.25						
Conductance (mS/cm)	0.447	0.390	0.382						
Dissolved Oxygen (mg/L)	45.1	44.1	44.1						
Turbidity (NTU)	96.0	60.3	59.6						
ORP (mV)	-13.4	8.1	14.3						

Time / Parameter	10	11	12	13	14
Volume Purged (ml)					
Depth to Water (ft. TIC)					
Temperature (°C)					
pH					
Conductance (mS/cm)					
Dissolved Oxygen (mg/L)					
Turbidity (NTU)					
ORP (mV)					

MISCELLANEOUS OBSERVATIONS/PROBLEMS

SAMPLE DESTINATION

Laboratory:
Shipped Via: ☐ Federal Express ☐ Other:
Sample was ☐ shipped day of sampling ☐ sent on
Chain of Custody Signed By:

T5 — Site

BBL — BLASLAND, BOUCK & LEE, INC. engineers & scientists

T5 GW11 — Event

GROUND-WATER SAMPLING LOG

Sampling Personnel: JRS
Job Number: 40015
Weather: Sunny ~35°F

Well ID. T5 mw-2
Date: 12/14/05
Time In: 10:00 Time Out: 11:20

WELL INFORMATION

		TIC	TOC	BGS
Well Depth	(feet)		23.80	
Water Table Depth	(feet)		9.27	

check where appropriate

Well Type: Flushmount ☐ Stick-Up ☒
Well Locked: Yes ☒ No ☐
Measuring Point Marked: Yes ☒ No ☐
Well Diameter: 1" ☐ 2" ☒ Other:

WELL WATER INFORMATION

Length of Water Column:	(feet)	14.53
Volume of Water in Well:	(gal)	2.37
Pumping Rate of Pump:	(mL/min)	600 mL/min
Pumping Rate of Pump:	(GPM)	~0.1 gpm
Minutes of Pumping:	(min)	45 min
Total Volume Removed:	(gal)	~5 gal

Conversion Factors

gallons per feet of water column:	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L =3785 mL = 0.1337 cubic ft.

Unit Stability

pH	DO	Cond	ORP
± 0.1	± 10%	± 3.0%	± 10 mV

SAMPLING INFORMATION

Analyses:
TCL VOCs ☐
TCL SVOCs ☐
Tal Inorganics (Exc. Cyanide) - Total ☐
Tal Inorganics (Exc. Cyanide) - Dissolved ☐
TCL PCBs - Total Metals ☒
TCL PCBs - Dissolved Metals ☒ - Field Filtered
Sample ID: T5-mw-2-GW-1
Sample Time: 10:55
MS/MSD: Yes ☒ No ☐
Duplicate: Yes ☐ No ☒
Duplicate ID: NA
Total Bottles: 6

EVACUATION INFORMATION

Evacuation Method: Bailer ☐ Peristaltic ☒ Grudfos ☐ Other Pump ☐
Tubing Used: Teflon ☒ Polyethylene ☐
Sampling Method: Bailer ☐ Peristaltic ☒ Grudfos ☐ Other Pump ☐

Did well go dry? Yes ☐ No ☒ Water Quality Meter Type: YSI 6920 w/ 650 MDS w/ flow through cell

Time / Parameter	1 10:26 Initial	2 10:30	3 10:34	4 10:38	5 10:42	6 10:46	7	8	9
Volume Purged (ml)	1.5 gal	2.0	2.5	3.0	3.25	3.6			
Depth to Water (ft. TIC)	9.26	9.27	9.27	9.27	9.27	9.27			
Temperature (°C)	12.87	12.95	12.70	12.81	12.67	12.76	SAMPLED		
pH	6.44	6.47	6.49	6.52	6.54	6.56			
Conductance (mS/cm)	0.209	0.237	0.272	0.294	0.310	0.317			
Dissolved Oxygen (mg/L)	0.50	0.31	0.25	0.13	0.12	0.06			
Turbidity (NTU)	27.8	16.9	9.50	5.79	3.79				
ORP (mV)	-64.7	-68.3	-69.1	-72.4	-74.5	-77.8			

Time / Parameter	10	11	12	13	14
Volume Purged (ml)					
Depth to Water (ft. TIC)					
Temperature (°C)					
pH					
Conductance (mS/cm)					
Dissolved Oxygen (mg/L)					
Turbidity (NTU)					
ORP (mV)					

MISCELLANEOUS OBSERVATIONS/PROBLEMS

SAMPLE DESTINATION

Laboratory: STL
Shipped Via: Federal Express ☐ Other: Courier ☒
Sample was shipped day of sampling ☒ sent on 12/15/05 ☒
Chain of Custody Signed By: JRS

TS
Site

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

TS GWM
Event

GROUND-WATER SAMPLING LOG

Sampling Personnel: JRS
Job Number: 40015
Weather: Sunny ~40°F

Well ID: TS-MW-3
Date: 12/14/05
Time In: 11:25 Time Out: 12:48

WELL INFORMATION

		TIC	TOC	BGS
Well Depth	(feet)		25.07	
Water Table Depth	(feet)		10.88	

check where appropriate

Well Type: Flushmount ☐ Stick-Up ☒
Well Locked: Yes ☒ No ☐
Measuring Point Marked: Yes ☒ No ☐
Well Diameter: 1" ☐ 2" ☒ Other: ____

WELL WATER INFORMATION

Length of Water Column:	(feet)	14.19
Volume of Water in Well:	(gal)	2-3gal
Pumping Rate of Pump:	(mL/min)	300 mL/min
Pumping Rate of Pump:	(GPM)	0.07 gpm
Minutes of Pumping:	(min)	45 min
Total Volume Removed:	(gal)	3gal

Conversion Factors

gallons per foot of water column:	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L = 3785 mL = 0.1337 cubic ft.

Unit Stability

pH	DO	Cond	ORP
± 0.1	± 10%	± 3.0%	± 10 mV

SAMPLING INFORMATION

Analyses:
TCL VOCs ☐
TCL SVOCs ☐
Tal Inorganics (Inc. Cyanide) - Total ☐
Tal Inorganics (Inc. Cyanide) - Dissolved ☐
~~TCL PCBs~~ - Total Metals ☒
~~TCL PCBs~~ - Dissolved Metals ☒ Field Filtered
Sample ID: TS-MW-3-GW-1
Sample Time: 11:58
MS/MSD: Yes ☐ No ☐
Duplicate: Yes ☒ No ☐
Duplicate ID: TS-MW-3-GW-2
Total Bottles: 4

EVACUATION INFORMATION

Evacuation Method: Bailer ☐ Peristaltic ☒ Grudfos ☐ Other Pump ☐ ____
Tubing Used: Teflon ☒ Polyethylene ☐
Sampling Method: Bailer ☐ Peristaltic ☒ Grudfos ☐ Other Pump ☐ ____

Did well go dry? Yes ☐ No ☒ Water Quality Meter Type: YSI 6920 w/ 650 MDS w/ flow through cell

Time / Parameter	1 11:42 Initial	2 11:46	3 11:50	4 11:54	5	6	7	8	9
Volume Purged (ml)	0.5	0.75	1.0	1.25					
Depth to Water (ft. TIC)	10.95	10.95	10.95	10.95					
Temperature (°C)	13.92	13.81	13.82	13.66					
pH	6.36	6.34	6.28	6.30	SAMPLED				
Conductance (mS/cm)	0.175	0.177	0.181	0.181					
Dissolved Oxygen (mg/L)	1.53	2.22	1.03	1.43					
Turbidity (NTU)	11.9	7.31	2.93	1.16					
ORP (mV)	-13.8	-21.6	-27.0	-31.3					

Time / Parameter	10	11	12	13	14
Volume Purged (ml)					
Depth to Water (ft. TIC)					
Temperature (°C)					
pH					
Conductance (mS/cm)					
Dissolved Oxygen (mg/L)					
Turbidity (NTU)					
ORP (mV)					

MISCELLANEOUS OBSERVATIONS/PROBLEMS

SAMPLE DESTINATION

Laboratory: STL
Shipped Via: Federal Express ☐ Other: courier
Sample was shipped day of sampling ☒ sent on 12/15/05 ☒
Chain of Custody Signed By: JRS

T5 — Site

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

T5 GWm — Event

GROUND-WATER SAMPLING LOG

Sampling Personnel: JRS
Job Number: 40015
Weather: Sunny ~35°F

Well ID: T5 mw-4
Date: 12/15/05
Time In: 08:35 Time Out:

WELL INFORMATION

		TIC	TOC	BGS
Well Depth	(feet)		24.55	
Water Table Depth	(feet)		8.10	

check where appropriate

Well Type: Flushmount ☐ Stick-Up ☒
Well Locked: Yes ☒ No ☐
Measuring Point Marked: Yes ☒ No ☐
Well Diameter: 1" ☐ 2" ☒ Other:

WELL WATER INFORMATION

Length of Water Column:	(feet)	16.45
Volume of Water in Well:	(gal)	2.68
Pumping Rate of Pump:	(mL/min)	300
Pumping Rate of Pump:	(GPM)	0.2
Minutes of Pumping:	(min)	~40
Total Volume Removed:	(gal)	~7gal

Conversion Factors

gallons per feet of water column:	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469

1 gal = 3.785 L = 3785 mL = 0.1337 cubic ft.

Unit Stability

pH	DO	Cond	ORP
± 0.1	± 10%	± 3.0%	± 10 mV

SAMPLING INFORMATION

Analyses:
TCL VOCs ☐
TCL SVOCs ☐
Tal Inorganics (Inc. Cyanide) - Total ☐
Tal Inorganics (Inc. Cyanide) - Dissolved ☐
~~TCL PCBs~~ - Total Metals ☒ field filtered
~~TCL PCBs~~ - Dissolved Metals ☒
Sample ID: T5-mw-4-GW-1
Sample Time: 10:01
MS/MSD: Yes ☐ No ☒
Duplicate: Yes ☐ No ☒
Duplicate ID: NA
Total Bottles: 2

EVACUATION INFORMATION

Evacuation Method: Bailer ☐ Peristaltic ☐ Grudfos ☒ Other Pump ☐ _____
Tubing Used: Teflon ☒ Polyethylene ☐
Sampling Method: Bailer ☐ Peristaltic ☐ Grudfos ☒ Other Pump ☐ _____

Did well go dry? Yes ☐ No ☒ Water Quality Meter Type: YSI 6920 w/ 650 MDS w/ flow through cell

Time / Parameter	1 9:19 Initial	2 9:22	3 9:28	4 09:55	5 09:57	6	7	8	9
Volume Purged (ml)	2gal	2.25	3 gal	6 gal	6.25				
Depth to Water (ft. TIC)	9.5	9.55	9.60	9.70	9.71				
Temperature (°C)	11.60	11.76	11.91	12.05	12.11				
pH	6.02	6.04	6.06	6.09	6.10	SAMPLED			
Conductance (mS/cm)	0.312	0.356	0.389	0.410	0.411				
Dissolved Oxygen (mg/L)	1.41	1.22	1.27	2.15	2.17				
Turbidity (NTU)	107.4	79.4	43.6	30.6	12.3				
ORP (mV)	32.7	20.2	13.9	15.8	15.1				

Time / Parameter	10	11	12	13	14
Volume Purged (ml)					
Depth to Water (ft. TIC)					
Temperature (°C)					
pH					
Conductance (mS/cm)					
Dissolved Oxygen (mg/L)					
Turbidity (NTU)					
ORP (mV)					

MISCELLANEOUS OBSERVATIONS/PROBLEMS

SAMPLE DESTINATION

Laboratory: STL
Shipped Via: ☐ Federal Express ☒ Other: courier
Sample was ☒ shipped day of sampling ☐ sent on _____
Chain of Custody Signed By: JRS

9/12/05 TS Well development JRS

08:30 JRS arrives on site Calls Jaimie Stevens (Retech) to notify that BBL is on site. Call Dave Brien (Port) to ask to on site assistance finding wells. DB is in a meeting until 9:00 will call back Jamie Stevens is on site at OSM and is monitoring wells.

09:00 Looking for wells - blocked by trees?

09:30 Calibrate YSI and prepare equipment for MW development

10:15 Call DB - still in meeting

10:30 DB called - will come to site now

11:00 Met DB - visit to wells. Discuss work plan - DB is concerned about stirring up sediments in well

11:30 Call Michael Pickering - agreed to purge well at high flow w/ peristaltic pump to purge but not surge well.

11:45 QAP discussed w/ DB - decided to use original plan: surge w/ Submersible pump - purge 73 casing volumes.

12/12/05 TS Well Development JRS

ID	DTW	Tot. Depth	Time
TSMW-2	9.16	23.30	11:39
TSMW-3	10.85	20.30	11:49
TSMW-4	7.73	23.60	11:54

Developing MW-2 - very turbid. Do not measure field parameters while purging initial 9-gal - v turbid. Purge additional 5 gal while measuring parameters All stabalize - turbidity continues to reduce.

Developing MW-3 - very turbid Do not measure field parameters while purging initial 6 gal. Surge and purge until parameters stabalize and turbidity continues to fall purge 13 gal.

Developing MW-4 purge ~11 gallons.

Label IDW drums w/ Non-haz label

16:30 Depart site

12/14/05 TS GW sampling JRS

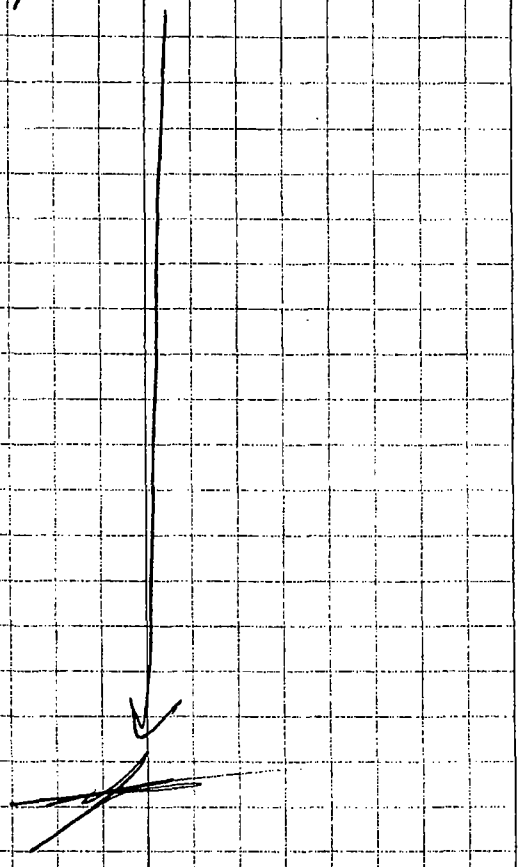
09:15 JRS arrives on site. Red flagging across field is blocking access to TS-mw-4. Inquire with TS (Kinder Morgan?) operations manager about crossing line to access well. Access is denied - will be possible on 12/15/05. Call Amanda Spencer to inform of access problem. Will collect samples at mw-2 and mw-3 today and return to sample mw-4 on 12/15/05.

10:00 Arrive at TS-mw-2 to collect groundwater sample: TS-mw-2-GW-1 for total and dissolved metals and MS/MSD

11:25 Arrive at mw-4 to collect TS-mw-2-GW-1 and TS-mw-2-GW-2 (duplicate)

for total and dissolved metals. Dispose of IDW in labeled drum next to TS-mw-2.

13:00 Depart site

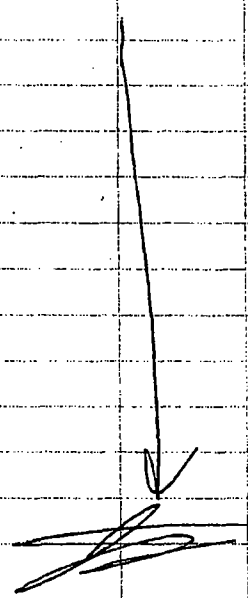


12/15/05 JRS

08:30 JRS Arrives on site. Talks to on site operations manager if ok to cross flagged-off area. He says ok - but retie tape when done.

08:35 Arrive at MW-04 and collect TS-MW04-GW-1 for total and dissolved metals. Dispose of IDW in drum located at MW-03

10:15 Depart site



Chain of Custody Record

STL Seattle
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.stl-inc.com

SEVERN TRENT STL®

Port of Portland (c/o Ash Creek)

Client	Project Manager	Date	Chain of Custody Number
[redacted]	Michael Pickering/Amanda Spencer	12/15/05	23552
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page 1 of 1**
9615 SW Allen Blvd. Suite 106	(503) 924-4704 (503) 924-4707		
City / **State** / **Zip Code**	**Site Contact**	**Lab Contact**	
Portland / OR / 972			
Project Name and Location (State)	**Carrier/Waybill Number**		
Port of Portland USC, Portland, OR			
Contract/Purchase Order/Quote No.			
40015			

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Analysis: Total Metals	Dissolved Metals	Special Instructions/ Conditions of Receipt
TS-MW-2-GW-1	12/14/05	10:55		✓					✓				✓	✓	Dissolved metals samples were field filtered.
TS-MW-3-GW-1	12/14/05	11:58		✓					✓				✓	✓	
TS-MW-3-GW-2	12/14/05	11:58		✓					✓				✓	✓	
TSMW-4-GW-1	12/15/05	10:01		✓					✓				✓	✓	

Cooler: ☒ Yes ☐ No Cooler Temp: _____

Possible Hazard Identification: ☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By: Mollie Hart	12/15/05	4:43	1. Received By: McClista SENVOY #76	12/15/05	4:43
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE – Stays with the Samples; CANARY – Returned to Client with Report; PINK – Field Copy

STL8274-580 (12/02)

Appendix C

Data QA/QC Review and Analytical Laboratory Reports

Appendix C – Data QA/QC Review

This appendix documents the results of a quality assurance (QA) review of the analytical data for groundwater samples collected during the December 2005 groundwater sampling event at the Terminal 5 Upland Facility. Severn Trent Laboratories (STL) of Tacoma, Washington, performed the analyses. A copy of the analytical laboratory report summary is included in this appendix.

The QA review included examination and validation of the laboratory summary report, including:

- Analytical methods;
- Detection limits;
- Sample holding times;
- Custody records;
- Surrogates, spikes, and blanks; and
- Duplicates.

The QA review did not include a review of raw data.

Analytical Methods and Detection Limits

Chemical analyses on all collected water samples consisted of the following:

- Total and dissolved metals (barium, iron, and manganese) by EPA Method 6020.

Quality Assurance Objectives and Review

The general QA objectives for this project were to develop and implement procedures for obtaining and evaluating data of a quality that could be used for uses such as a risk assessment for the site. To collect such information, analytical data must have an appropriate degree of accuracy and reproducibility, samples collected must be representative of actual field conditions, and samples must be collected and analyzed using unbroken chain of custody procedures.

Reporting limits and analytical results were compared to action levels for each parameter in the media of concern. Precision, accuracy, representativeness, completeness, and comparability parameters used to indicate data quality are defined below.

Reporting Limits. Detection limits are set by the laboratory and are based on instrumentation abilities, sample matrix, and suggested detection limits by the Environmental Protection Agency (EPA) or the Department of Environmental Quality (DEQ). In some cases, the detection limit has been raised due to high concentrations of

analytes in the samples or matrix interferences. Detection limits were generally consistent with industry standards and all method reporting limits were below the relevant SLV standards.

Reporting limits were reviewed and are generally acceptable for this project. Reporting limits for individual samples varied based on the magnitude of the chemical impact. The maximum sample dilution was 5 times, due to high levels of the reported analyte or matrix interference. It is not expected that any of the raised detection limits compromised the usability of the data.

Holding Times. All samples were analyzed within the holding times specified for the requested analyses.

Precision. Precision measures the reproducibility of data under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average values. Analytical precision is measured through matrix spike/matrix spike duplicate (MS/MSD) samples for VOC analyses. Analytical precision is quantitatively expressed as the relative percent difference (RPD) between the MS/MSD. The laboratory also prepares a batch laboratory control sample and duplicate (LCS and LCSD). All MS/MSD and LCS/LCSD results were within acceptable ranges.

Accuracy. Accuracy is the measure of error between the reported test results and the true sample concentration. "Perfect" accuracy is 100 percent recovery. True sample concentration is never known due to analytical limitations and error. Consequently, accuracy is inferred from the recovery data from spiked samples. The laboratory performed sufficient spike samples of a similar matrix (i.e., water) to allow the computation of the accuracy.

The accuracy measurements were carried out in accordance with SW-846 method requirements. All surrogate spike results were within acceptable ranges.

The field-collected duplicate sample of MW-3 (labeled as T5-MW-3-GW-2) had detected concentrations similar to the original sample (labeled as T5-MW-3-GW-1). The percent difference between the original and duplicate sample ranged from 0 to 8 percent, depending on the analyte.

Representativeness. Representativeness is a measure of how closely the results reflect the actual concentration of the chemical parameters in the medium sampled. Sampling procedures, as well as sample-handling protocols for storage, preservation, and transportation, are designed to preserve the representativeness of the samples collected. Laboratory method blanks are run in accordance with established laboratory protocols.

All samples for this project were received by the laboratory in good condition and in the proper, laboratory supplied containers. For the total recoverable metals analyses, barium and manganese were detected in the laboratory blank (at 0.000022 and 0.00012 mg/L, respectively). For the dissolved metals analyses, iron and manganese were detected in the method blank (at 0.0025 and 0.000036 mg/L, respectively). These detected concentrations are a minimum of three orders of magnitude less than the lowest detection of these metals in the groundwater samples. Since the concentrations detected in the groundwater samples are more than 5 times higher than the concentrations detected in the method blanks, the data are considered acceptable and are not flagged.

Completeness. Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness of the data is the number of acceptable data points divided by the total number of data points multiplied by 100. The completeness goal is essentially that a sufficient amount of valid data can be generated to allow for the evaluation of the site investigation.

No data collected during the site investigation were rejected for this project; therefore, the completeness for this phase of the project is 100 percent.

Comparability. Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Based on this QA review, the quality of the data collected during this site investigation is similar to that of previously collected data and is, therefore, comparable.

Conclusion. In conclusion, the overall QA objectives have been met, and the data (as qualified) are of adequate quality for use in this project.

ANALYTICAL REPORT

Job Number: 580-931-1

Job Description: Terminal 5 Upland Facility

For:

Ash Creek Associates, Inc.
9615 SW Allen Blvd
Suite 106
Portland, OR 97005

Attention: Michael Pickering

Darla Powell
Project Manager II
dpowell@stl-inc.com
12/30/2005

SAMPLE SUMMARY

Client: Ash Creek Associates, Inc. Job Number: 580-931-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
580-931-1	T5-MW-2-GW-1	Water	12/14/2005 1055	12/16/2005 1230
580-931-1MSMS	T5-MW-2-GW-1	Water	12/14/2005 1055	12/16/2005 1230
580-931-1MSDMSD	T5-MW-2-GW-1	Water	12/14/2005 1055	12/16/2005 1230
580-931-2	T5-MW-3-GW-1	Water	12/14/2005 1158	12/16/2005 1230
580-931-3	T5-MW-3-GW-2	Water	12/14/2005 1158	12/16/2005 1230
580-931-4	T5-MW-4-GW-1	Water	12/15/2005 1001	12/16/2005 1230

Client: Ash Creek Associates, Inc. Job Number: 580-931-1

Client Sample ID: T5-MW-2-GW-1

Lab Sample ID: 580-931-1 Date Sampled: 12/14/2005 1055
Client Matrix: Water Date Received: 12/16/2005 1230

6020 Inductively Coupled Plasma - Mass Spectrometry-Total Recoverable

Method: 6020 Analysis Batch: 580-2598 Instrument ID: PE Sciex Elan 6100
Preparation: 3005A Prep Batch: 580-2563 Lab File ID: N/A
Dilution: 5.0 Initial Weight/Volume: 50 mL
Date Analyzed: 12/27/2005 1413 Final Weight/Volume: 50 mL
Date Prepared: 12/27/2005 1006

Analyte	Result (mg/L)	Qualifier	MDL	RL
Barium	0.095	B	0.000059	0.0025
Iron	2.8		0.0050	0.0050
Manganese	0.76	B	0.000042	0.0025

6020 Inductively Coupled Plasma - Mass Spectrometry-Dissolved

Method: 6020 Analysis Batch: 580-2660 Instrument ID: PE Sciex Elan 6100
Preparation: N/A Lab File ID: N/A
Dilution: 5.0 Initial Weight/Volume: 50 mL
Date Analyzed: 12/28/2005 0905 Final Weight/Volume: 50 mL
Date Prepared: N/A

Analyte	Result (mg/L)	Qualifier	MDL	RL
Barium	0.091		0.000059	0.0025
Iron	3.2	B	0.0050	0.0050
Manganese	0.79	B	0.000042	0.0025

Client: Ash Creek Associates, Inc. Job Number: 580-931-1

Client Sample ID: T5-MW-3-GW-1

Lab Sample ID:	580-931-2	Date Sampled:	12/14/2005 1158
Client Matrix:	Water	Date Received:	12/16/2005 1230

6020 Inductively Coupled Plasma - Mass Spectrometry-Total Recoverable

Method:	6020	Analysis Batch: 580-2598	Instrument ID:	PE Sciex Elan 6100
Preparation:	3005A	Prep Batch: 580-2563	Lab File ID:	N/A
Dilution:	5.0		Initial Weight/Volume:	50 mL
Date Analyzed:	12/27/2005 1431		Final Weight/Volume:	50 mL
Date Prepared:	12/27/2005 1006			

Analyte	Result (mg/L)	Qualifier	MDL	RL
Barium	0.012	B	0.000059	0.0025
Iron	2.7		0.0050	0.0050
Manganese	0.56	B	0.000042	0.0025

6020 Inductively Coupled Plasma - Mass Spectrometry-Dissolved

Method:	6020	Analysis Batch: 580-2660	Instrument ID:	PE Sciex Elan 6100
Preparation:	N/A		Lab File ID:	N/A
Dilution:	5.0		Initial Weight/Volume:	50 mL
Date Analyzed:	12/28/2005 0948		Final Weight/Volume:	50 mL
Date Prepared:	N/A			

Analyte	Result (mg/L)	Qualifier	MDL	RL
Barium	0.0092		0.000059	0.0025
Iron	1.7	B	0.0050	0.0050
Manganese	0.48	B	0.000042	0.0025

Client: Ash Creek Associates, Inc. Job Number: 580-931-1

Client Sample ID: T5-MW-3-GW-2

Lab Sample ID: 580-931-3 Date Sampled: 12/14/2005 1158
Client Matrix: Water Date Received: 12/16/2005 1230

6020 Inductively Coupled Plasma - Mass Spectrometry-Total Recoverable

Method: 6020 Analysis Batch: 580-2598 Instrument ID: PE Sciex Elan 6100
Preparation: 3005A Prep Batch: 580-2563 Lab File ID: N/A
Dilution: 5.0 Initial Weight/Volume: 50 mL
Date Analyzed: 12/27/2005 1434 Final Weight/Volume: 50 mL
Date Prepared: 12/27/2005 1006

Analyte	Result (mg/L)	Qualifier	MDL	RL
Barium	0.011	B	0.000059	0.0025
Iron	2.7		0.0050	0.0050
Manganese	0.57	B	0.000042	0.0025

6020 Inductively Coupled Plasma - Mass Spectrometry-Dissolved

Method: 6020 Analysis Batch: 580-2660 Instrument ID: PE Sciex Elan 6100
Preparation: N/A Lab File ID: N/A
Dilution: 5.0 Initial Weight/Volume: 50 mL
Date Analyzed: 12/28/2005 0951 Final Weight/Volume: 50 mL
Date Prepared: N/A

Analyte	Result (mg/L)	Qualifier	MDL	RL
Barium	0.0093		0.000059	0.0025
Iron	1.6	B	0.0050	0.0050
Manganese	0.50	B	0.000042	0.0025

Client: Ash Creek Associates, Inc. Job Number: 580-931-1

Client Sample ID: T5-MW-4-GW-1

Lab Sample ID: 580-931-4 Date Sampled: 12/15/2005 1001
Client Matrix: Water Date Received: 12/16/2005 1230

6020 Inductively Coupled Plasma - Mass Spectrometry-Total Recoverable

Method: 6020 Analysis Batch: 580-2598 Instrument ID: PE Sciex Elan 6100
Preparation: 3005A Prep Batch: 580-2563 Lab File ID: N/A
Dilution: 5.0 Initial Weight/Volume: 50 mL
Date Analyzed: 12/27/2005 1437 Final Weight/Volume: 50 mL
Date Prepared: 12/27/2005 1006

Analyte	Result (mg/L)	Qualifier	MDL	RL
Barium	0.051	B	0.000059	0.0025
Iron	1.7		0.0050	0.0050
Manganese	0.52	B	0.000042	0.0025

6020 Inductively Coupled Plasma - Mass Spectrometry-Dissolved

Method: 6020 Analysis Batch: 580-2660 Instrument ID: PE Sciex Elan 6100
Preparation: N/A Lab File ID: N/A
Dilution: 5.0 Initial Weight/Volume: 50 mL
Date Analyzed: 12/28/2005 0954 Final Weight/Volume: 50 mL
Date Prepared: N/A

Analyte	Result (mg/L)	Qualifier	MDL	RL
Barium	0.040		0.000059	0.0025
Iron	1.0	B	0.0050	0.0050
Manganese	0.49	B	0.000042	0.0025

DATA REPORTING QUALIFIERS

Client: Ash Creek Associates, Inc. Job Number: 580-931-1

Lab Section	Qualifier	Description
Metals		
	U	Analyte was not detected at or above the reporting limit.
	B	Compound was found in the blank and sample.
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Client: Ash Creek Associates, Inc.

Job Number: 580-931-1

Method Blank - Batch: 580-2563

Method: 6020
Preparation: 3005A
Total Recoverable

Lab Sample ID: MB 580-2563/16-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 12/27/2005 1532
Date Prepared: 12/27/2005 1006

Analysis Batch: 580-2598
Prep Batch: 580-2563
Units: mg/L

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	MDL	RL
Barium	0.000022	J	0.000012	0.00050
Iron	0.0010	U	0.0010	0.0010
Manganese	0.00012	J	0.0000083	0.00050

Laboratory Control/
Laboratory Control Duplicate Recovery Report - Batch: 580-2563

Method: 6020
Preparation: 3005A
Total Recoverable

LCS Lab Sample ID: LCS 580-2563/17-A
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/27/2005 1535
Date Prepared: 12/27/2005 1006

Analysis Batch: 580-2598
Prep Batch: 580-2563
Units: mg/L

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

LCSD Lab Sample ID: LCSD 580-2563/18-A
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/27/2005 1538
Date Prepared: 12/27/2005 1006

Analysis Batch: 580-2598
Prep Batch: 580-2563
Units: mg/L

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	% Rec. LCS	% Rec. LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Barium	106	104	80 - 120	2	20		
Iron	107	103	80 - 120	4	20		
Manganese	103	102	80 - 120	1	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Ash Creek Associates, Inc.

Job Number: 580-931-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 580-2563

Method: 6020
Preparation: 3005A
Total Recoverable

LCS Lab Sample ID: LCS 580-2563/17-A
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/27/2005 1535
Date Prepared: 12/27/2005 1006

Units: mg/L

LCSD Lab Sample ID: LCSD 580-2563/18-A
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/27/2005 1538
Date Prepared: 12/27/2005 1006

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Barium	4.00	4.00	4.3	4.2
Iron	22.0	22.0	23	23
Manganese	1.00	1.00	1.0	1.0

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 580-2563

Method: 6020
Preparation: 3005A
Total Recoverable

MS Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/27/2005 1419
Date Prepared: 12/27/2005 1006

Analysis Batch: 580-2598
Prep Batch: 580-2563

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

MSD Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/27/2005 1422
Date Prepared: 12/27/2005 1006

Analysis Batch: 580-2598
Prep Batch: 580-2563

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	% Rec. MS	% Rec. MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Barium	113	115	75 - 125	1	20	B	B
Iron	115	118	75 - 125	3	20		
Manganese	114	111	75 - 125	1	20	B	B

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Ash Creek Associates, Inc.

Job Number: 580-931-1

Matrix Spike/
Matrix Spike Duplicate Data Report - Batch: 580-2563

Method: 6020
Preparation: 3005A
Total Recoverable

MS Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/27/2005 1419
Date Prepared: 12/27/2005 1006

Units: mg/L

MSD Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/27/2005 1422
Date Prepared: 12/27/2005 1006

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual		MSD Result/Qual	
Barium	0.095	4.00	4.00	4.6	B	4.7	B
Iron	2.8	22.0	22.0	28		29	
Manganese	0.76	1.00	1.00	1.9	B	1.9	B

Matrix Duplicate - Batch: 580-2563

Method: 6020
Preparation: 3005A
Total Recoverable

Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 5.0
Date Analyzed: 12/27/2005 1416
Date Prepared: 12/27/2005 1006

Analysis Batch: 580-2598
Prep Batch: 580-2563
Units: mg/L

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
Barium	0.095	0.093	2	20	B
Iron	2.8	2.8	0	20	
Manganese	0.76	0.76	0	20	B

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Ash Creek Associates, Inc.

Job Number: 580-931-1

Method Blank - Batch: 580-2660

Method: 6020
Preparation: N/A

Lab Sample ID: MB 580-2660/1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 12/28/2005 0859
Date Prepared: N/A

Analysis Batch: 580-2660
Prep Batch: N/A
Units: mg/L

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	MDL	RL
Barium	0.00050	U	0.000012	0.00050
Iron	0.0025		0.0010	0.0010
Manganese	0.000036	J	0.0000083	0.00050

Laboratory Control/
Laboratory Control Duplicate Recovery Report - Batch: 580-2660

Method: 6020
Preparation: N/A

LCS Lab Sample ID: LCS 580-2660/6
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/28/2005 0922
Date Prepared: N/A

Analysis Batch: 580-2660
Prep Batch: N/A
Units: mg/L

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

LCSD Lab Sample ID: LCSD 580-2660/7
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/28/2005 0925
Date Prepared: N/A

Analysis Batch: 580-2660
Prep Batch: N/A
Units: mg/L

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	% Rec. LCS	% Rec. LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Barium	103	102	80 - 120	1	20		
Iron	104	103	80 - 120	1	20		
Manganese	109	108	80 - 120	2	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Ash Creek Associates, Inc.

Job Number: 580-931-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 580-2660

Method: 6020
Preparation: N/A

LCS Lab Sample ID: LCS 580-2660/6
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/28/2005 0922
Date Prepared: N/A

Units: mg/L

LCSD Lab Sample ID: LCSD 580-2660/7
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/28/2005 0925
Date Prepared: N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Barium	4.00	4.00	4.1	4.1
Iron	22.0	22.0	23	23
Manganese	1.00	1.00	1.1	1.1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 580-2660

Method: 6020
Preparation: N/A

MS Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/28/2005 0912
Date Prepared: N/A

Analysis Batch: 580-2660
Prep Batch: N/A

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

MSD Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/28/2005 0915
Date Prepared: N/A

Analysis Batch: 580-2660
Prep Batch: N/A

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	% Rec. MS	% Rec. MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Barium	103	103	75 - 125	0	20		
Iron	103	107	75 - 125	3	20	B	B
Manganese	99	102	75 - 125	1	20	B	B

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Ash Creek Associates, Inc.

Job Number: 580-931-1

Matrix Spike/
Matrix Spike Duplicate Data Report - Batch: 580-2660

Method: 6020
Preparation: N/A

MS Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/28/2005 0912
Date Prepared: N/A

Units: mg/L

MSD Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 50
Date Analyzed: 12/28/2005 0915
Date Prepared: N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual		MSD Result/Qual	
Barium	0.091	4.00	4.00	4.2		4.2	
Iron	3.2	22.0	22.0	26	B	27	B
Manganese	0.79	1.00	1.00	1.8	B	1.8	B

Matrix Duplicate - Batch: 580-2660

Method: 6020
Preparation: N/A

Lab Sample ID: 580-931-1
Client Matrix: Water
Dilution: 5.0
Date Analyzed: 12/28/2005 0908
Date Prepared: N/A

Analysis Batch: 580-2660
Prep Batch: N/A
Units: mg/L

Instrument ID: PE Sciex Elan 6100
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
Barium	0.091	0.092	1	20	
Iron	3.2	3.1	2	20	B
Manganese	0.79	0.78	1	20	B

Calculations are performed before rounding to avoid round-off errors in calculated results.

Chain of Custody Record

STL Seattle
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.stl-inc.com

SEVERN TRENT STL®

Port of Portland (c/o Ash Creek)

Client	Project Manager	Date	Chain of Custody Number
[redacted]	Michael Pickering/Amanda Spencer	12/15/05	23552

Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page
9615 SW Allen Blvd. Suite 106	(503) 924-4704 (503) 924-4707		1 of 1

City	State	Zip Code	Site Contact	Lab Contact
Portland	OR	972		

Project Name and Location (State): Port of Portland USC, Portland, OR

Carrier/Waybill Number:

Contract/Purchase Order/Quote No.: 40015

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Analysis: Total Metals	Dissolved Metals												Special Instructions/ Conditions of Receipt
1 TS-mw-2-GW-1	12/14/05	10:55		↓					↓				↓	↓												Dissolved metals samples were field filtered.
2 TS-mw-3-GW-1	12/14/05	11:58																								
3 TS-mw-3-GW-2	12/14/05	11:58																								
4 TS-mw-4-GW-1	12/15/05	10:01		↓					↓				↓	↓												

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Cooler: ☒ Yes ☐ No Cooler Temp:_____

Possible Hazard Identification: ☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☒ Disposal By Lab ☐ Return To Client ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☐ Other _____

QC Requirements (Specify):

	Relinquished By	Date	Time	Received By	Date	Time
1	Mollie Hart	12/15/05	4:43	J McClusky SENVOY #76	12-15-05	4:43
2	[signature]	12/16/05	1230	JCR	12/16/05	1230p
3						

Comments:

DISTRIBUTION: WHITE – Stays with the Samples; CANARY – Returned to Client with Report; PINK – Field Copy

STL8274-580 (12/02)

LOGIN SAMPLE RECEIPT CHECK LIST

Client: Ash Creek Associates, Inc.

Job Number: 580-931-1

Login Number: 931

Question	T/F/NA	Comment
Radioactivity either was not measured or, if measured, is at or below background		
The cooler's custody seal, if present.		
The cooler or samples do not appear to have been compromised or tampered with.		
Samples were received on ice.		
Cooler Temperature is acceptable.		
Cooler Temperature is recorded.		
COC is present.		
COC is filled out in ink and legible.		
COC is filled out with all pertinent information.		
There are no discrepancies between the sample IDs on the containers and the COC.		
Samples are received within Holding Time.		
Sample containers have legible labels.		
Containers are not broken or leaking.		
Sample collection date/times are provided.		
Appropriate sample containers are used.		
Sample bottles are completely filled.		
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs		
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.		
If necessary, staff have been informed of any short hold time or quick TAT needs		
Multiphasic samples are not present		
Samples do not require splitting or compositing		